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# Mentor Visual iQ VideoProbe User's Manual



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# Introduction

## About this Manual

This manual and the related equipment is intended for visual inspection technicians with a basic understanding of inspection principles and practices, and who are familiar with basic computer operations, but who may not have experience with a video borescope system. The manual contains safety, compliance, and basic operating and maintenance instructions for the Visual iQ VideoProbe™ system. To ensure operator safety, please read and understand this manual prior to using the system.

## Technical Support

For additional assistance, go to [www.ge-mcs.com](http://www.ge-mcs.com) for a complete listing of contact information. Technical Support contact information follows:

Global Phone: 1-866-243-2638

Email: RemoteService@GE.com

## System Overview

The rugged and dependable Mentor Visual iQ® system is an advanced flexible video borescope used for remote visual inspection.

Working through access passages, the Visual iQ system delivers high-resolution images of internal details of turbine engines, airframes, automotive engines, piping, vessels, wind-turbine gear boxes, underwater structures, etc.

With TrueSight™, Mentor Visual iQ delivers HD visuals, a high-intensity light source, and superior visual processing, for clearer, sharper videos and still images right on your device. The probe's fiberoptic bundle illuminates the inspection area with light generated by an advanced Light Engine in the probe. At the end of the probe, a miniature camera assembly converts the image into an electronic image, and sends it back through the probe. The system displays the image on the handset. No focusing is required, because the Visual iQ system contains a fixed-focus optical system with a large depth of field.

Measurement capabilities (standard with the Visual iQ Analyze configuration) allow your system to analyze and measure indications and features. Real3D™ provides a fully surfaced point cloud of the target surface to view, manipulate and optimize measurement cursor locations.

The Visual iQ system is compatible with USB thumb drives, USB keyboards, USB portable drives, and most other USB-based storage devices.

With our QuickChange™ interchangeable probes, you can quickly reconfigure the system for maximum productivity. This feature is available with either the Visual iQ Touch or Analyze configuration.

Available in three versions (identified as the **Inspect**, **Touch**, and **Analyze** configurations) to meet diverse inspection needs across industries. Refer to the guide on the following page to determine the right one for your application.

## Standard Equipment

Visual iQ  
2-hour Li-Ion Battery  
Visual iQ Storage Case

AC Adapter/Battery Charger  
Optical Tip Storage Case  
USB Thumbdrive Containing Documentation, including User's Manual

Safety and Essential Use Hard Copy  
Quickstart Card

## Optional Features

Display Port Video Cable  
Insertion Tube Gripper  
Insertion Tube Rigidizer  
Handset Holder  
Headset (wired or wireless)  
Cables  
Belt Clip

Keyboard (wired or wireless)  
Optical Tips  
Measuring Optical Tips  
Mini-Magic Arm Clamp Kit  
Magic Arm Kit  
External Monitor  
Large Visual iQ Case

Software: **Inspection Manager** (Re-measurement PC Application)  
Upgrade either **Visual iQ Touch** or **Analyze** configurations with the purchase of *3D Phase* or *3D Stereo measurement*, *STEREO measurement*, or *Probability of Detection* capabilities. Features included in the *Probability of Detection* upgrade includes HDR (High-Dynamic Range), ANR (Adaptive Noise Reduction), Distortion Correction, and Preset Image Transformation Settings.  
**InspectionWorks Connect**, internet-based video collaboration capability.  
**Insight** is a Cloud-based data storage option.  
**iView** is a feature that allows users to control system with a iPad®

## Mentor Visual iQ – Available in Three Configurations

<u>Mentor Visual iQ Inspect*</u>	<u>Mentor Visual iQ Touch*</u>	<u>Mentor Visual iQ Analyze**</u>
Excellent image quality and connectivity in a value-priced package. <b>Upgradable to Touch or Analyze configurations.</b>	Adds the versatility of interchangeable probes and productivity enhancements. <b>Upgradable to Analyze configuration.</b>	Sets the industry standard with powerful measurement and analysis software combined with extreme image quality and greater probability of detection.
<ul style="list-style-type: none"> <li>■ Value priced option</li> <li>■ Choose from 7 probe length and diameter configurations</li> </ul>	<b>All the features of Mentor Visual iQ Inspect, plus...</b> <ul style="list-style-type: none"> <li>■ Interchangeable probes</li> <li>■ Touchscreen interface</li> <li>■ Menu-Directed-Inspection software</li> <li>■ 16GB internal memory</li> </ul>	<b>All the features of Mentor Visual iQ Touch, plus...</b> <ul style="list-style-type: none"> <li>■ 3D Phase Measurement</li> <li>■ 3D Stereo Measurement</li> <li>■ <i>Probability of Detection</i> upgrade, which includes High-Dynamic Range, Adaptive Noise Reduction, Distortion Correction, and Preset Image Transformations</li> </ul>

\*Purchase 3D Phase measurement, 3D Stereo measurement, Stereo measurement, or Probability of Detection upgrades

\*\*Purchase Stereo measurement as an option

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# Safety Information

**Note:** Before using or servicing the system, read and understand the following safety information.

## Symbols and Terms

The following symbols appear on the product:  ,  . See accompanying documentation.

## General Warnings

The following warning statements apply to use of the system in general. Warning statements that apply specifically to particular procedures appear in the corresponding sections of the manual.



Do not allow the conductive insertion tube, system or its working tools to come in direct contact with any voltage or current source. Prevent all contact with live electrical conductors or terminals. Damage to the equipment and/or electrical shock to the operator may result.



Do not use this system in explosive environments.



USE PROPERLY. Using any piece of this equipment in a manner not specified by the manufacturer may impair the product's ability to protect the user from harm.



## General Cautions

The following caution statements apply to use of the Visual iQ device in general. Caution statements that apply specifically to particular procedures appear in the corresponding sections of the manual.

Before using the camera system, install an optical tip or the head guard, which prevents damage to the tip-attachment mechanism. Keep the head guard on whenever no optical tip is in place.

**Handle the Probe Carefully:** Keep the insertion tube away from sharp objects that might penetrate its outer sheath. Keep the whole insertion tube as straight as possible during operation; loops or bends anywhere in the tube decrease its ability to steer the probe tip. Avoid bending the insertion tube sharply.

**Note:** Always use the [Home](#) function to straighten the bending neck before withdrawing insertion tube from an inspection area or putting probe away. Never pull, twist, or straighten the bending neck by hand; internal damage may result. At the first sign of damage, return the probe for repair.

Certain substances may damage the probe. For a list of substances that are safe for the probe, see "[Chemical Compatibility](#)" in the Appendix.

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## Battery Warnings

Only use the battery and power supply specified for use with the system. Before use, thoroughly review the instructions in this manual for the battery and battery charger to fully understand the information contained in them, and observe the instructions during use.



### WARNING

- Do not place the battery in fire or exceed the battery operating temperature.
- Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.
- Do not expose the battery to water or salt water, or allow the battery to get wet (IP65 – Disassembled, IP67 – Assembled).
- Do not disassemble or modify the battery.
- The instrument contains a Lithium Ion battery and magnesium in its case. Should the instrument be involved in a fire, use an extinguisher approved for use on electrical and flammable metal fires. Water must not be used.



**Battery Communication Error:** Exists when the Visual IQ shows this message on the display. If the problem persists, please contact your nearest customer support center.

Using the battery outside its recommended operating range will result in degradation of the performance and service life. When storing the battery, be sure to remove it from the handset.

Recommended ambient temperature range for Li-ion battery operation:

Discharge (when using the instrument): -20°C to 46°C

Recharging: 0°C to 40°C

Storage: -25°C to +60°C

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# Informations sur la sécurité

**Remarque:** avant l'utilisation ou l'entretien du système, vous devez lire et comprendre les informations de sécurité qui suivent.

## Symboles et termes employés

Les symboles suivants sont apposés **sur le produit**: , . Voir la documentation jointe.

## Avertissements généraux

Les avertissements suivants s'appliquent à l'utilisation du système en général. Les avertissements qui s'appliquent spécifiquement à des procédures particulières sont indiqués dans les sections correspondantes de ce manuel.



Le système Visual iQ et les outils de travail qui l'accompagnent ne doivent jamais entrer en contact direct avec une source de tension ou de courant. Évitez tout contact avec des conducteurs ou des bornes électriques sous tension. L'équipement risquerait d'être endommagé, ou l'opérateur de subir un choc électrique.



N'utilisez pas ce système dans un environnement à risque d'explosion.



UTILISER CORRECTEMENT. Si un élément de cet équipement est utilisé d'une manière non indiquée par le fabricant, l'utilisateur peut ne plus être protégé des risques de blessure.



## Mentions générales « Attention »

Les mentions « Attention » qui suivent s'appliquent à l'utilisation de l'appareil Visual iQ en général. Les mentions « Attention » qui s'appliquent spécifiquement à des procédures particulières sont indiquées dans les sections correspondantes du manuel.

**MANIPULER LA SONDE AVEC PRÉCAUTION.** Maintenez la gaine de la sonde à l'écart d'objets pointus ou tranchants qui risqueraient de traverser son fourreau. Maintenez toute la gaine aussi droite que possible pendant l'utilisation : en cas de boucle ou de courbure, il est plus difficile de piloter le bout de la sonde. Évitez de trop courber la gaine.

**Remarque :** utilisez toujours le bouton de rangement pour redresser le béquillage avant de rétracter la gaine de la zone d'inspection ou de ranger la sonde. Ne manipulez jamais le béquillage à la main pour le tirer, le courber ou le redresser : vous risqueriez de l'endommager à l'intérieur. Envoyez la sonde en réparation au premier signe d'endommagement.

Certaines substances risquent d'endommager la sonde. Pour consulter la liste des substances sans danger pour la sonde, voir Compatibilité Chimique en annexe.

L'appareil comporte une batterie lithium ion et du magnésium à l'intérieur de son boîtier. En cas d'incendie de l'appareil, servez-vous d'un extincteur agréé pour une utilisation sur les incendies électriques et les métaux inflammables. En aucun cas, n'utilisez de l'eau.



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## Avertissements liés à la batterie

Utilisez uniquement la batterie et l'alimentation spécifiées pour être utilisées avec le système Visual IQ. Avant utilisation, lisez attentivement les instructions contenues dans ce manuel relatives à la batterie et au chargeur de batterie pour bien les comprendre, et respectez ces instructions pendant l'utilisation de l'appareil.



### AVERTISSEMENT

- Ne jetez pas la batterie au feu et ne dépassez pas sa température de fonctionnement.
- Ne percez pas la batterie avec des clous, ne la frappez pas avec un marteau, ne marchez pas dessus et ne la soumettez pas à des impacts ou des chocs violents.
- N'exposez pas la batterie à l'eau douce ou salée, et évitez de la mouiller.
- Ne désassemblez pas la batterie et ne la modifiez pas.

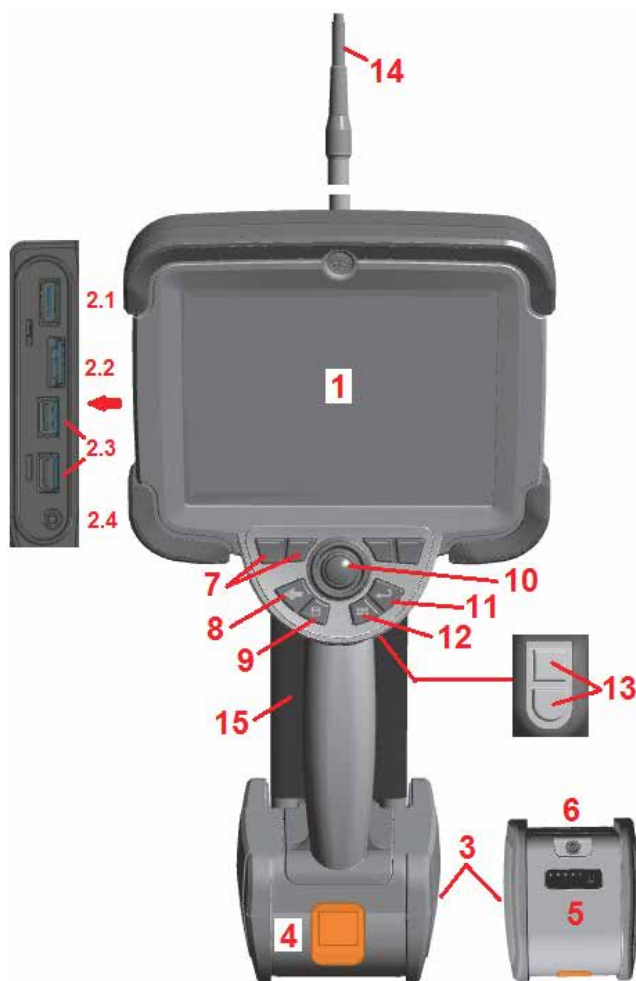


**Erreur de communication de la batterie.** Veuillez contacter le Service clientèle au numéro +1 315 554 2000.

L'utilisation de la batterie en dehors de la plage de fonctionnement recommandée entraînerait une dégradation de ses performances et de sa longévité. Lorsque vous stockez la batterie, veillez à la retirer de sa base.

Plage de température recommandée pour le fonctionnement de la batterie Lithium-Ion.

Décharge (à l'utilisation de l'appareil) : -20°C à +46°C Recharge , 0°C à +40°C Stockage, -25°C à +60°C



# Start Up

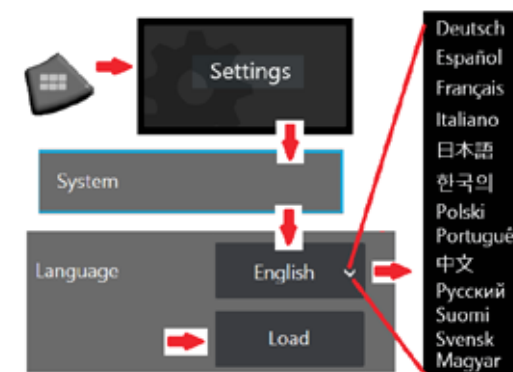
## Component Identification

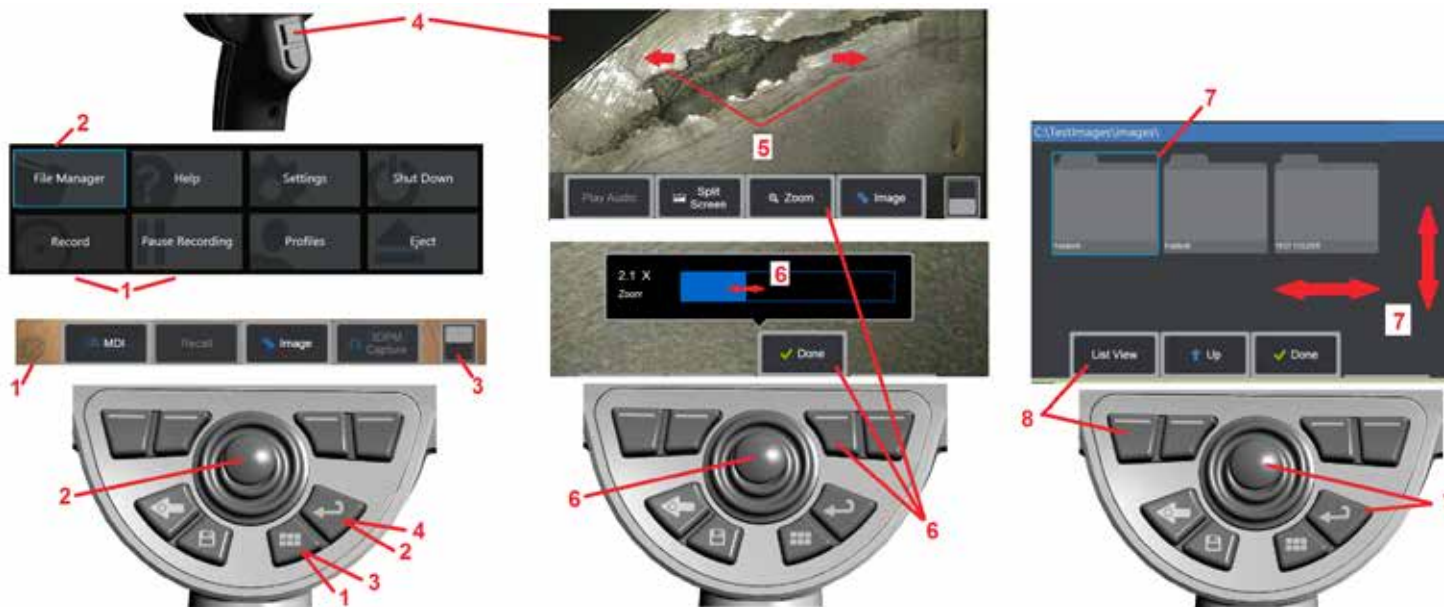
- 1 – LCD Touchscreen
- 2 – DisplayPort Output (2.1), USB 3.0 Client Micro B Port (2.2), Two USB 3.0 Host Type A Ports (2.3), 3.5 mm Headset/Microphone Jack (2.4).
- 3 – Two-hour Lithium Ion Battery
- 4 – Battery Release Button
- 5 – Battery Charge Indicator
- 6 – AC Adaptor Input
- 7 – Function (or Soft) Keys (four total)
- 8 – Back Button: short press moves back one screen, long press moves to live screen. This also serves as the **POWER ON** button.
- 9 – Save Button: short press launches a **Quick Save**, long press opens or closes the **Save Options Menu**. Double press to record a **Screenshot**.
- 10 – Joystick Controls Articulation and Menu Navigation (push the joystick left/right/up/down to navigate menus and sub-menus).
- 11 – Enter Button: short press toggles between frozen and live frames and selects **Done / Accept**, a long press performs a **3DPM Capture**.

Hard Key	Name	Short Press	Long Press	Double Press
	Back button (and Power On)	Moves back one screen	Moves to live image	
	Save button	Quick save (assigns default name and location)	Save with options available	Record a Screenshot
	Menu button	Opens or closes Global Menu	Toggles between first and second rows of soft buttons	
	Enter button	Toggles between live and frozen images. Also confirm selection (Done/Accept).	Performs 3DPM capture	
	Trigger buttons (upper and lower)	Upper is same as Enter button Lower toggles articulation mode between steer-and-stay and steering modes	Upper is same as Enter button Lower returns articulation system to neutral position	

**Note: Follow the selection sequence shown here to select the Operating Language.**

- 12 – Menu Button: short press opens or closes the Global Menu, long press toggles between first and second level soft button rows.
- 13 – Trigger Button 1 (Upper): provides the same function as the Enter Button. Trigger Button 2 (Lower): short press toggles articulation mode between steer-and-stay and steering modes. When in steer-and-stay mode, a Lock icon appears. Long press returns the articulation system to the neutral (home) position.
- 14 – Insertion Tube/Camera assembly
- 15 – Interchangeable VideoProbe (**Note:** Includes Insertion Tube/Camera assembly)





## Touchscreen and Keys – Dual Control Systems

*Most functions can be accomplished using the touchscreen or with a combination of key presses and joystick movements. The following examples illustrate various control techniques that can be used on most Visual IQ display screens.*

**1** – Touch the lower left corner of the display screen (typically contains the **GE Logo**) or short-press the **Menu key** to open the **Global Menu**.

**2** – The selected item in any menu or list is identified by this **blue outline**. Tap the display screen to select another item or to launch the selected item. Alternatively, use the **joystick** to select another item by moving the blue cursor, then short-press the **Enter key** to launch. **Note that a short press of the Enter key accepts or launches most selected choices or actions.**

**3** – Tap the display to toggle between the upper and lower softkey bar (double-tap to hide or show the softkey and status bars). Alternatively, long-press the **Menu key** to switch between the upper and lower softkey bars.

**4** – Tap anywhere on a displayed **Live Image** to freeze and unfreeze it. Alternatively, short-press either the **Enter key** or the **Upper Trigger key** to freeze and unfreeze a live display. **Note that the Upper Trigger key performs the identical functions as the Enter key.**

**5** – Position two fingers on the display screen and move them apart to zoom in on a feature of the display (perform the opposite action to zoom out). Once zoomed (in a frozen image), you can drag with your finger to change the displayed view.

**6** – Select the **Zoom** function using either soft keys or the touch screen (all displayed soft-key bar items can be selected either with the corresponding soft key or by tapping the touch screen). Use the **joystick** to change the **zoom magnification bar** (this and other blue bars can also be adjusted by dragging them using the touch screen), then select **Done**. Once zoomed, you can use the **joystick** to move the displayed view.

**7** – When the **File Manager** screen appears, the selected file or folder is identified by this **blue outline**. Tap the display screen to select another item or to launch the selected file or open the selected folder. **Note that you can also display additional items (or directly access additional stored images) by simply swiping the display screen in any of the directions shown.** Alternatively, use the **joystick** to select another item by moving the **blue cursor**, then short-press the **Enter key** to launch the file or open the folder.

**8** – Select any feature in the **Soft Key Bar** by either touching that feature on the display screen (in this case, touching the box containing the words **List View**) or pressing the corresponding **soft key**.

**Note: Connecting a Bluetooth or USB-wired keyboard allows for remote control of iQ functions and probe articulation. See [Appendix O](#) for a list of function key and key-press combinations equivalent to iQ button and joystick operations.**

# Unpacking, Assembling, and Powering the Visual iQ

## Unpacking and Putting Away the System (Small Case)

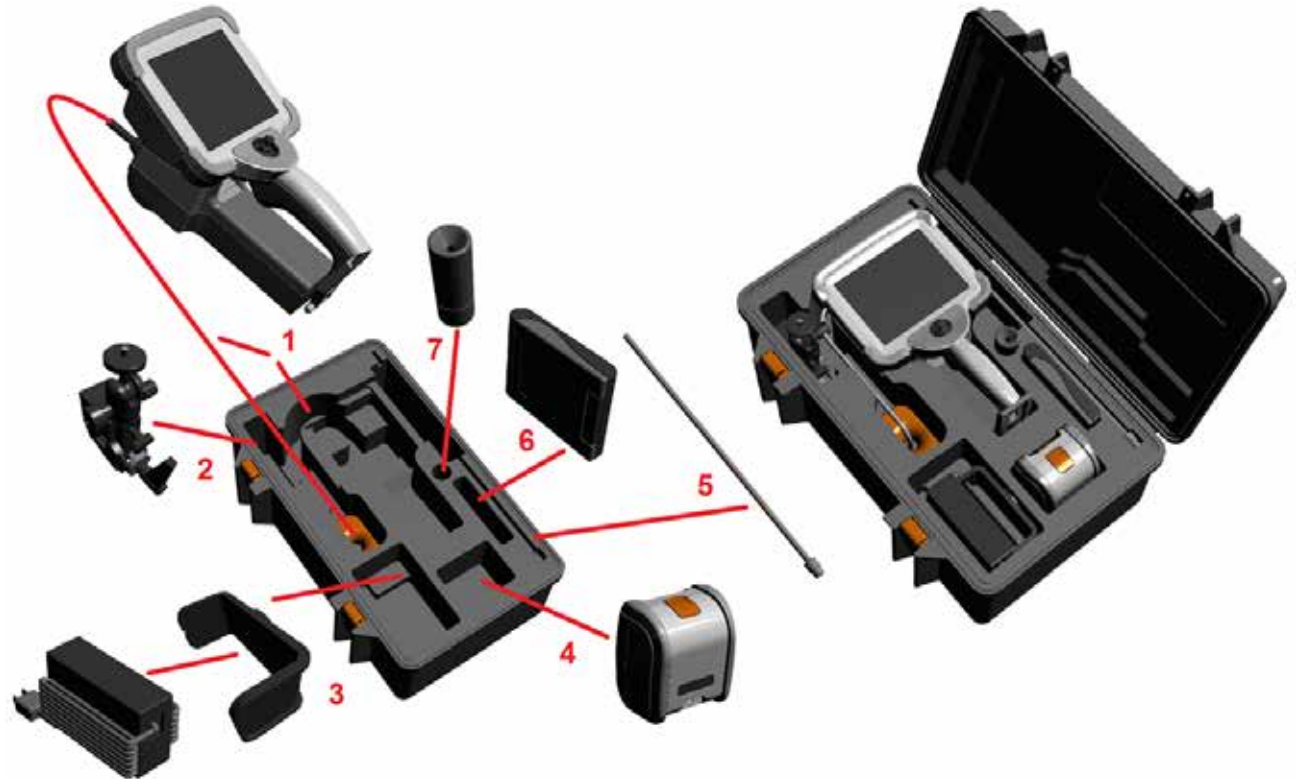


**Caution:** If you do not pack the system carefully, as described here, damage might occur.

**1** – The insertion tube (shown in red for clarity) is held in the case's internal storage reel, which is accessed through the orange funnel shown here. Install the insertion tube before installing the probe-and-handset assembly and remove it after removing the probe-and-handset assembly. Be sure to straighten any loops or twists in the insertion tube before feeding it into the funnel. Note that the insertion tube's rubber Torsional Strain Relief base should be routed through the case's curved passage shown here.



**Caution:** Before using the camera system, install an optical tip or the head guard, which prevents damage to the tip-attachment mechanism. Keep the head guard on whenever no optical tip is in place.



**2** – Install clamp in the orientation shown here (clamp and mounting bracket assembly appears at left)

**3** – Power supply / Battery Charger and Mounting Bracket are oriented and installed in this slot

**4** – Battery must be removed prior to installing the iQ in the case.

**5** – Rigidizer

**6** – A case holding tips (or cleaning kit) fits in this slot.

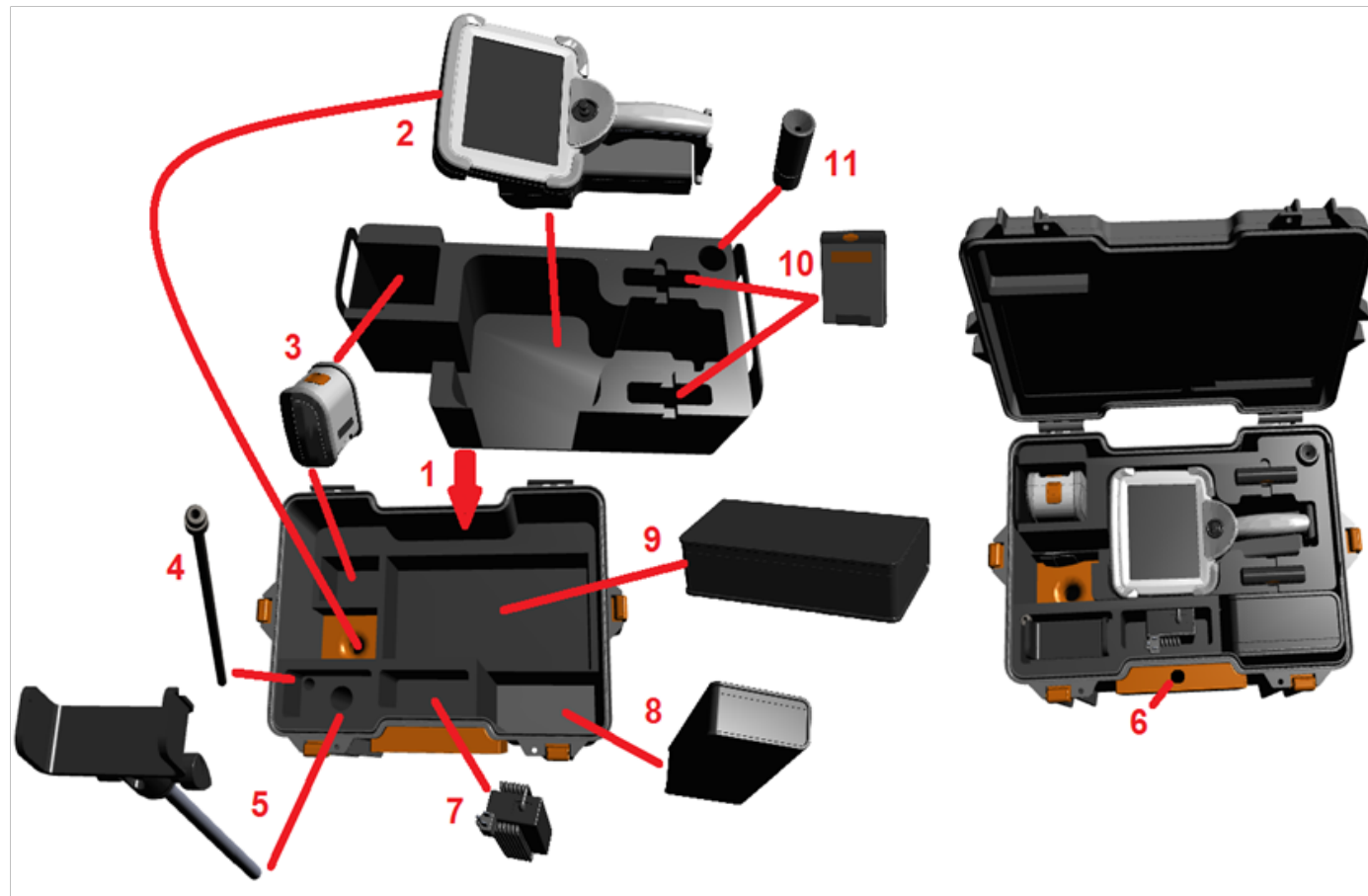
**7** – Gripper may be used alone, or with Rigidizer, to aid in orienting camera.


## Unpacking and Putting Away the System (Large Case)

 **Caution:** If you do not pack the system carefully, as described here, damage might occur.

**1** – Remove tray to access additional storage space.

**2** – The insertion tube (**shown in red for clarity**) is held in the case's internal storage reel, which is accessed through the orange funnel shown here. Install the insertion tube before installing the probe-and-handset assembly and remove it after removing the probe-and-handset assembly. Be sure to straighten any loops or twists in the insertion tube before feeding it into the funnel.



 **Caution:** Before storing the insertion tube, first remove the optical tip and install the head guard, which prevents damage to the tip attachment mechanism. Keep the head guard on whenever no optical tip is in place.

**3** – Storage locations for two batteries. Battery must be removed prior to installing the iQ in the case.

**4** – Rigidizer

**5** – Mounting bracket and post

**6** – Mounting bracket post fits in this hole

**7** – Power supply / Battery Charger installed in this slot

**8** – Extra Pod in case

**9** – Extra VideoProbe in case

**10** – Two cases holding tips and a cleaning kit fit in these slots.

**11** – Gripper may be used alone, or with Rigidizer, to aid in orienting camera.



## About the Battery

The Visual iQ is powered by a 10.8 V (nominal), 73 Wh, 6.8 Ah Lithium Ion battery.

### Installing the Battery

Insert the battery into the handset. The battery is installed properly when the latching mechanism is engaged.



Caution—Do not force the battery (1) into the handset (2), as damage may occur. The battery is keyed and may only be installed in the proper orientation.

### Removing the Battery

Press battery release button (3) to release the battery.



Caution—Do not remove the battery while the system is operating.

### Battery Charge Level

Check the battery charge by pressing the battery symbol (4) on the front of the battery. Each light (5) represents approximately 20% of the battery charge capacity.

### Charging the Battery

Connect the DC output of the battery charger into the Visual iQ battery (6) and then plug the included AC to DC power adaptor into a suitable AC power source. The LED battery lights will illuminate according to the amount of charge attained. The system may operate while charging.

**Note:** The battery may be charged while connected to an operating Visual iQ or while disconnected from the iQ.

**Note:** When the battery is fully charged, the LED battery lights will turn off.

**Note:** Battery run time approximately equals battery charge time; therefore, a two hour battery will take approximately two hours to charge. Charging time will be longer if the battery is connected to an operating Visual iQ system while charging.

**Note:** All batteries are shipped with a partial charge. Batteries should be fully charged prior to use.



## Supplying Power to the Visual iQ

The Visual iQ is powered by a 10.8 V (nominal), 73 Wh, 6.8 Ah Lithium Ion battery.

The battery is charged by connecting the power adaptor to the battery, then connecting the supplied AC-to-DC power adaptor to a suitable (100-240 VAC, 50-60 Hz, <1.5 A rms) AC power source. The power adaptor delivers to the battery 18 Volts at 3.34 Amps.

**Note:** When powering a system with an AC power source, connect the power plug to a properly grounded source for reliable touchscreen operation.

## Powering the Visual iQ On and Off

### System Power On




Press and hold until the unit turns on. The buttons and Liquid Crystal Display (LCD) will light and begin the power-up sequence. After approximately 35 seconds, the system screen will display live video and on-screen controls. The system is now ready for use.

**Note:** All batteries are shipped with a partial charge. Batteries should be fully charged prior to use.

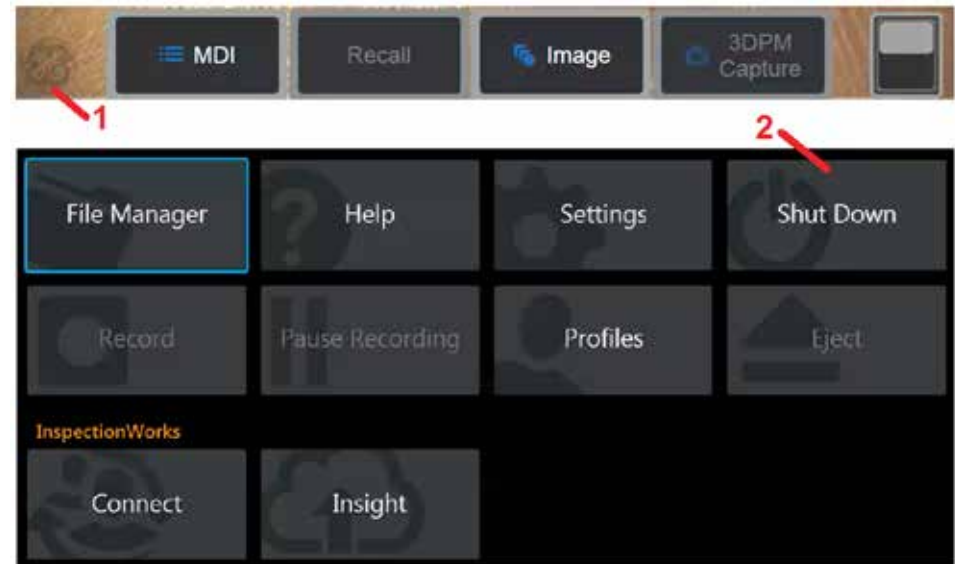
### System Power Off

Touch the lower left corner of the display screen (which typically contains the on-screen

**GE Logo** (1) or the  hard key at any time to open or close the **Global Menu**, which provides access to several features including **Shut Down** (2). Select **Shut Down** to power off the Visual iQ.



**Caution**—Do not power off the Visual iQ by removing its battery. Only remove battery after powering off as described above.





## Changing Probes and Optical Tips

### Attaching and Removing the Probe

**To attach the probe to the handset:**

- 1** – Insert the pin at the base of the handset into the mating groove at the bottom of the probe.
- 2** – Rotate the probe towards the back of the handset, applying enough pressure for the latching mechanism to “click.”

**To remove the probe from the handset:**

- 3** – Press this latching-mechanism's release button to separate the probe and handset.

### Changing the Optical Tip

Optical tips are threaded onto the probe with a double set of threads to prevent them from falling into the inspection area. Each optical tip provides a unique depth of field, field of view, and direction of view. For a list of available tips, see [Appendix B – Optical Tip Table](#).

**⚠ Caution**—Use only finger pressure to remove or attach tips. Using force (including pliers or other tools) might damage the bending neck. Take care not to cross the threads. To reduce cross-threading risk: When installing a tip by hand (6.1mm & 8.4mm) or with an installation tool (4mm), rotate the tip counter clockwise to **level** the threads before rotating clockwise to thread the tip on the camera. Reverse the leveling process when removing tips.

**To Remove an Optical Tip:** Support the bending neck and head of the probe with one hand, and with the other gently turn the optical tip counterclockwise (be sure to use a tip tool when removing 4.0 mm tips), Turn until the tip spins freely, indicating that it has cleared the first set of threads. Gently pull the tip away from probe and continue turning counterclockwise, engaging the second set of threads. Turn until you can remove it.

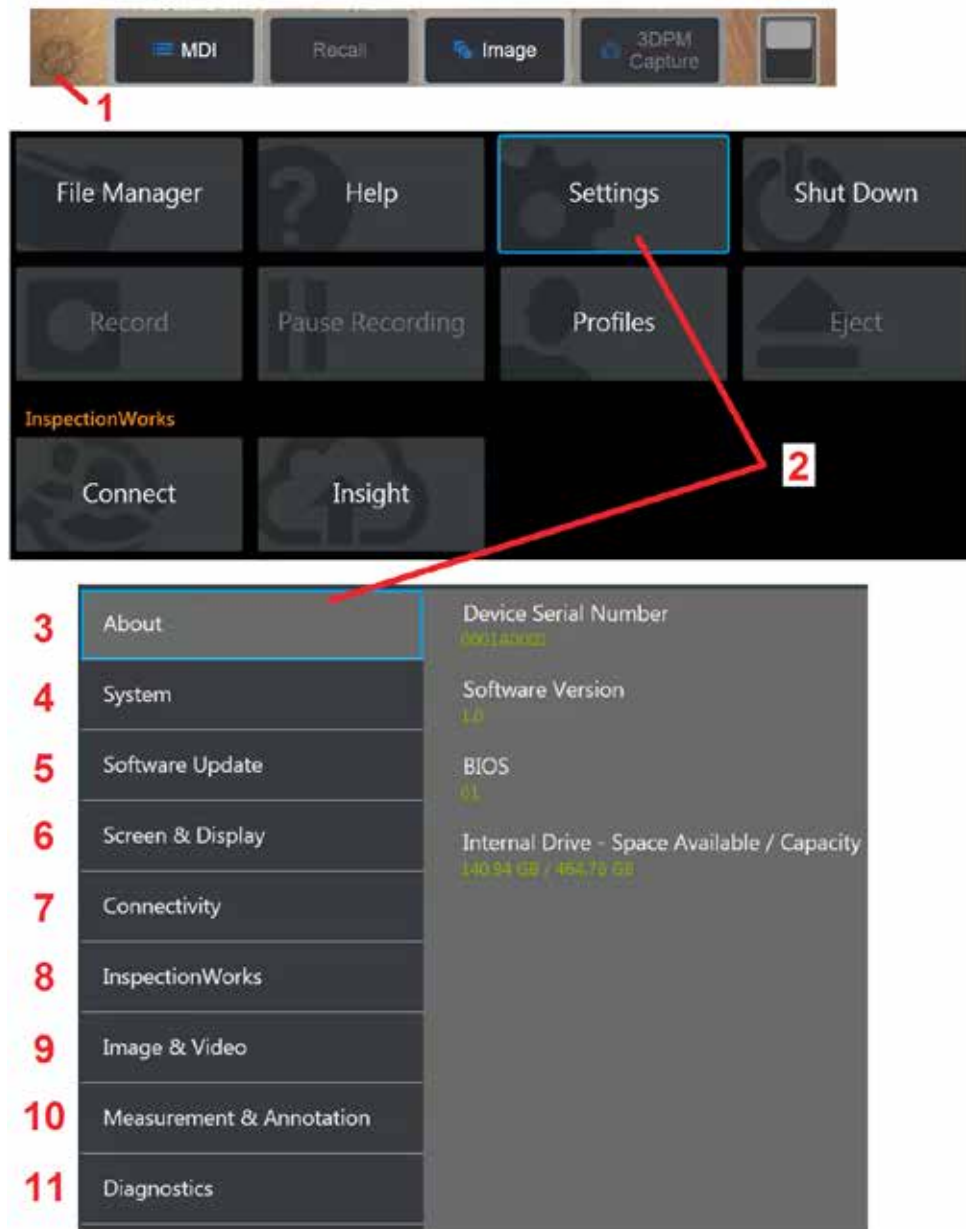


**To Attach an Optical Tip:** Verify that the optical tip and camera head threads are clean, then grasp the head of the probe with one hand, and with the other gently turn the tip clockwise. Turn until it spins freely, indicating that it has cleared the first set of threads. Gently push the tip in, then turn clockwise again, engaging the second set of threads. Turn until finger tight.

**⚠ Caution**—Do not over-tighten tips. Pull on the tip gently to verify that it is securely attached. If the second set of threads does not engage, turn the tip slightly in a counterclockwise direction to allow the threads to levelize.


**Note:** Measurement tips must be tightened firmly to ensure accuracy.





# Setting Up the Visual iQ Operating System

**1** – Select the lower left corner of the display (which typically contains the on-screen

GE Logo) or the  hard key at any time to open or close the **Global Menu**, which provides access to several features including the **Settings Menu**.

**2** – Tap to open the **Settings Menu**.

**3** – Lists the device's serial number and software version.

**4** – Access to set a Password, Restore Defaults, adjust Date, Time, and operating Language, and alter various other system settings. [Click here to learn more about the System Menu.](#)

**5** – Control automatic software update capability and manually update through web connection or connected USB drive.

**6** – Allows the user to turn various on-screen indicators on and off as well as adjust display brightness. [Click here to learn more about Display Setup.](#)

**7** – Allows the user to turn Wi-Fi and Bluetooth connections on and off as well as work with networks and identify folders for file sharing. [Click here to learn more about Connectivity Settings.](#)

**8** – Settings related to optional internet service that enables video collaboration between inspectors and remotely located experts.


**9** – Allows the user to specify the default directories into which image files and videos are stored. Also used to select image file type, video format, and sound-related settings. Controls MDI Annotation and imports Distortion Correction Tables. [Click here to learn more about Image and Video Settings.](#)

**10** – Allows the user to set their preferred measurement units (inches vs. mm), manage and verify measurement tips, select the desired annotation style, and import and export preset annotations.

**11** – Generates a Troubleshooting Log to be emailed to and evaluated by GE Technical Support. If log generation is required, GE Technical Support will guide the user through the process.

## Working with Profiles

A Profile defines several parameter settings. As long as more than one profile is available, (the Visual iQ is delivered with only a **Default Profile**), the operator is asked to select a **Profile** every time the system is powered on. Follow these instructions to create a new profile or select an existing one.

**1** – To create a **New Profile**, touch the lower left corner of the display (or press the  hard key) to open the **Global Menu**, then select **Profiles**.

**2** – In this case, the **Default Profile** is active and it is the only one defined. Select **New** to create a new profile.

**3** – The **Virtual Keyboard** opens. Enter a **Name** for the new profile.

**4** – After entering a name and clicking **Done**, the new profile is added to the list of available profiles. This profile includes the settings in place, at the time of its creation, for each of the parameters listed below. Anytime the profile is reactivated, the system will apply the settings associated with the activated profile. The parameters affected include:

### System Settings Including:

- Watermark Logo ON/OFF
- Time Format
- Date Format
- Language
- Power Management
- USB Slave Mode
- Steering Sensitivity

### Image & Video Settings – *All parameters except Distortion Correction Table*

### Measurement & Annotation Including:

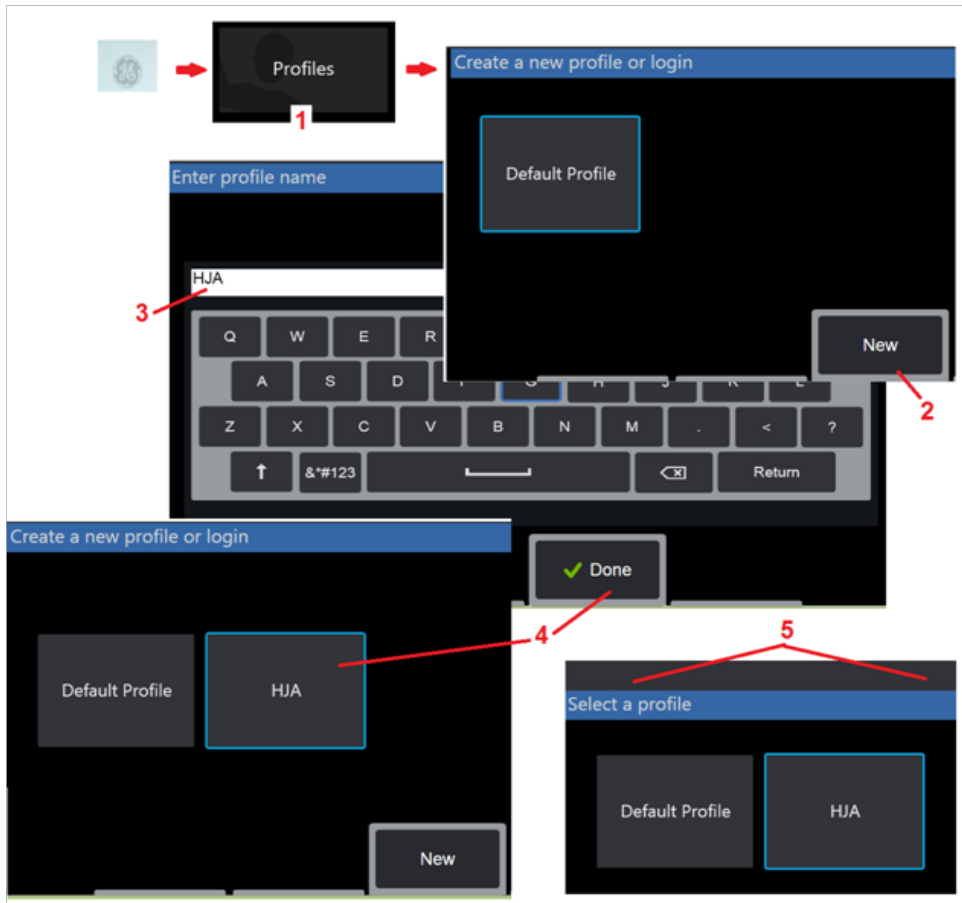
- Presets
- Zoom Window
- 3DPM Mask
- 3DPM Save Format
- Stereo Index
- Stereo Index Minimum
- Units

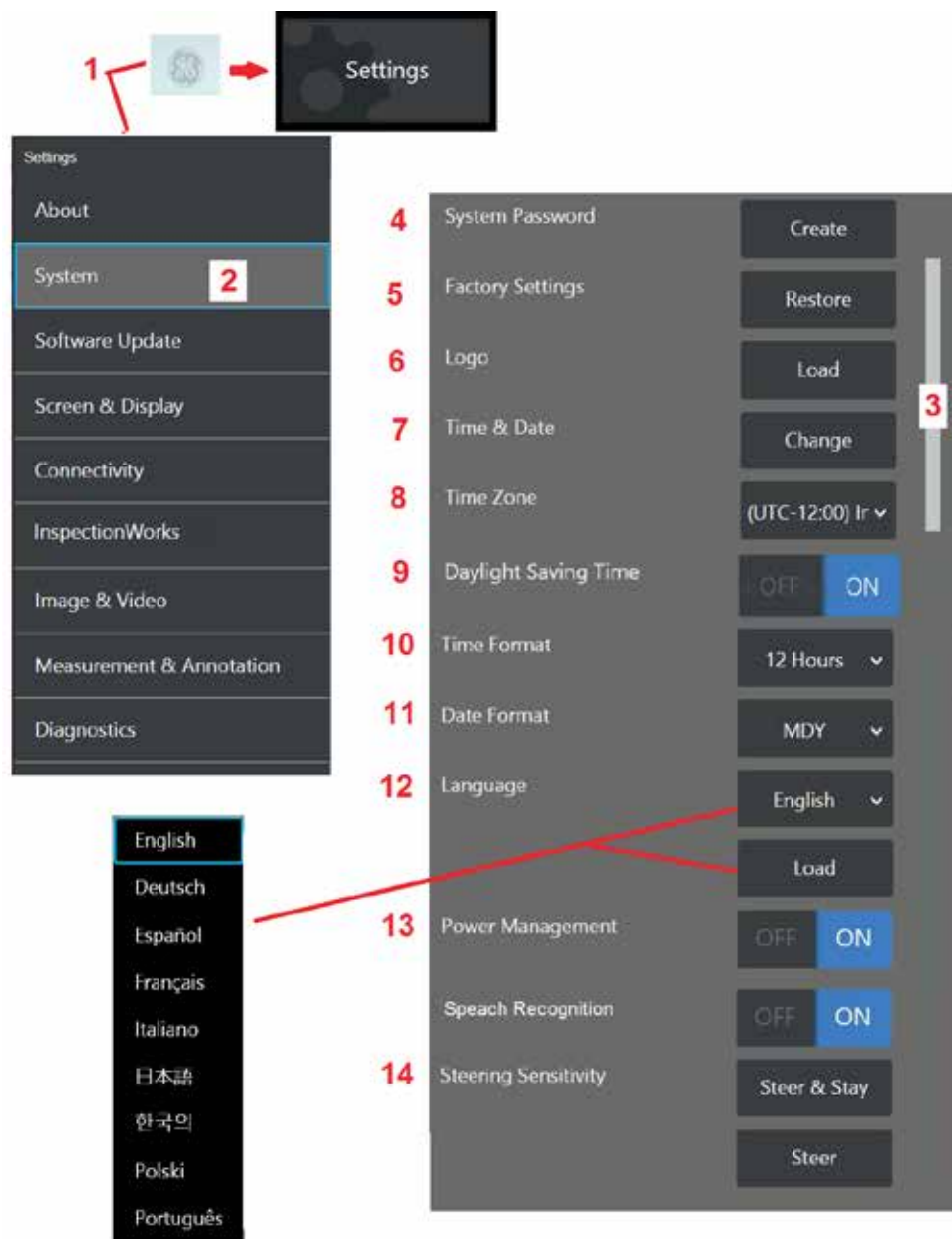
### Screen & Display Settings – *All Parameters*

### Connectivity Settings Including:


- Wi-Fi on/off
- Bluetooth on/off

**5** – Each time the Visual iQ is powered on, you'll be asked to select from the list of available profiles. Selecting the Default Profile returns the settings for all profile-controlled parameters to those specified by the default profile.





## System Setup

**1** – Tap the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then open the **Settings Menu**.

**2** – Select to alter the system-specific settings shown here.

**3** – Drag your finger up or down the screen. This bar will move to show the current position among the list of system-specific settings.

**4** – Tap to open the virtual keyboard and create or change a **System Password**. Once created, accessing the iQ's operating screens requires first entering the password. This password is for the entire system and is not associated with the active profile.

**Note:** Entering a password requires the **Default Profile** be active.

**5** – Select and follow the on-screen prompts to restore the active **Profile** to the **Factory Default Settings**.

### Loading a Logo

A logo can be loaded onto the display screen provided it is PNG file type (with dimensions smaller than 140 x 140).

**6** – Select **Load**, then navigate the instrument or an external drive to select any PNG file type as the on-screen logo. [Click here for more information on creating and loading a personalized logo file.](#)

### Setting Date and Time

**7** – Adjust **Time** and **Date** settings.

**8** – Select the **Time Zone** in which you are operating.

**9** – Indicate whether or not the instrument should automatically adjust for time changes due to **Daylight Savings**.

**10** – Specify 12 or 24 hour **Time Format**.

**11** – Specify **DMY**, **YMD**, or **MDY** as the **Date Format**.

## Loading and Selecting the Operating Language

**12** – Choose from the operating **Languages** currently available for use. Selecting **Load** allows you to upload a new version of any of the existing translations available in the iQ. Once selected, the File Manager screen allows you to navigate to the modified translation file.

## Other System Settings

**13** – Setting **Power Management** to **ON** conserves battery power by putting the Visual iQ into sleep mode after 10 minutes of inactivity. When in sleep mode, in which only the hard keys remain lit, touching any key or the joystick returns the iQ to a fully powered state.


## Steering Sensitivity Settings

**14** – The user can select from two probe steering modes: **Steer** or **Steer and Stay™**. In either mode, the bending neck articulates to follow the joystick motion. The modes differ in how they behave after the bending neck is positioned ([click here to learn about the differences between these modes](#)). Select either button shown here then drag the setting bar to set the sensitivity of either **Steer** or **Steer and Stay** mode. The higher the setting, the more the bending neck will articulate with a change in joystick position. For instance, increasing the setting from 2.0 to 4.0 means that a similar joystick movement will produce a greater amount of bending neck articulation.



## Screen & Display Setup



**1** – Tap the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then open the **Settings Menu**.

**2** – Select to alter the display-screen appearance and operation.

**3** – Turn the display screen's touch-sensitive control **ON** or **OFF**. Once turned **OFF**, the icon shown here appears at the top of the display screen. Once disabled, use a combination of joystick and hard key press to re-enable the touchscreen.

**4** – The **Tip Map** (shown here) graphically represents the extent to which the optical tip is articulated by positioning a bright dot at some distance from the crosshairs. The closer the dot appears to the center of the crosshairs, the straighter the tip's position.

**5** – The customizable watermark shown here appears in the bottom left corner of the display screen. Tapping this location opens the **Global Menu**. Turning this icon **OFF** causes it to disappear while tapping in its former location still opens the menu.

**6** – Turn the displayed date and time, which appears on the status bar at the display's upper right corner, **ON** or **OFF**.

**7** – Select to turn the **Sound Recording** and/or **Sound Recording Muted** icons (shown here) **ON** or **OFF**. These icons appear in the display's bottom right corner when recording video with an audio stream. Note that when these icons are visible (turned **ON**), selecting the onscreen icon mutes or unmutes the sound recording.


**8** – Display or hide touch-screen pause and play controls during video recording.

**9** – Control the display's brightness by using your finger to drag this bar right or left (or

select with the joystick, press  and then position with the joystick).



## Connectivity Setup

**1** – Tap the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then open the **Settings Menu**.

**2** – Select to work with settings that control the connection of the Visual IQ to WiFi networks and Bluetooth devices.

**3** – Turn the WiFi connection **ON** or **OFF**. Once turned **ON**, the icon shown here appears at the top of the display screen.

### Making Bluetooth Connections

**4** – Turn the **Bluetooth** connection **ON** or **OFF**. Once turned **ON**, the icon shown here appears at the top of the display screen. The icon is gray if Bluetooth is **ON** or white if Bluetooth is **ON and paired** with a device. Then, select **Connect** to display a list of available **Bluetooth Devices** to which the iQ can connect.

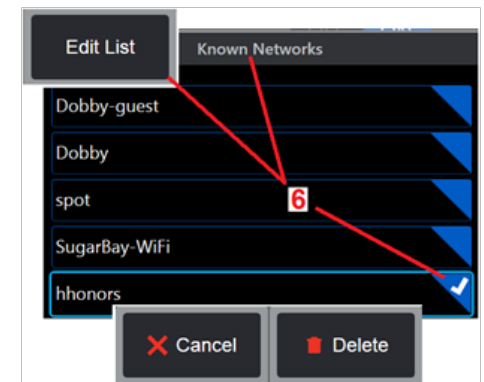
**5** – Available **Bluetooth Devices** that appear on this list can be paired with by simply tapping the on-screen listing. Note that pairing a keyboard may require inputting a PIN. When the device status switches from **Not Paired** to **Paired**, it is in Bluetooth communication with the Visual IQ. **Note: Connecting a Bluetooth or USB-wired keyboard allows for remote control of iQ functions and probe articulation. See Appendix O for a list of function key and key-press combinations equivalent to iQ button and joystick operations.**

### Working with WiFi

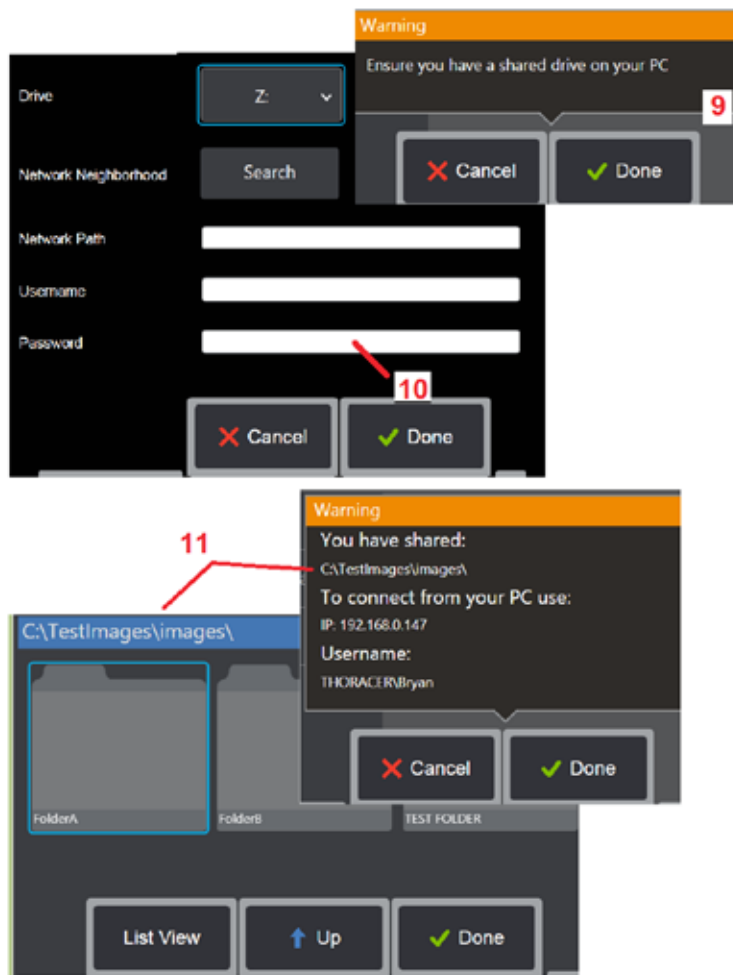
**6** – Select **Connect** to display a list of available **WiFi** networks to which the iQ can connect. Tap the screen to select an already known network from this list. (Select **Manage Known Networks** at any time to review the list of already-recognized networks and/or **Edit** the list by removing networks to which you no longer wish to automatically connect). Once **Edit List** is selected, tap the blue corner of any network to delete it from the list.

**7** – If prompted by the onscreen instructions, use the **Virtual Keyboard** to enter the network's password.

**8** – Selecting **Add Network** allows you to enter the SSID and security information for a hidden network not shown above.







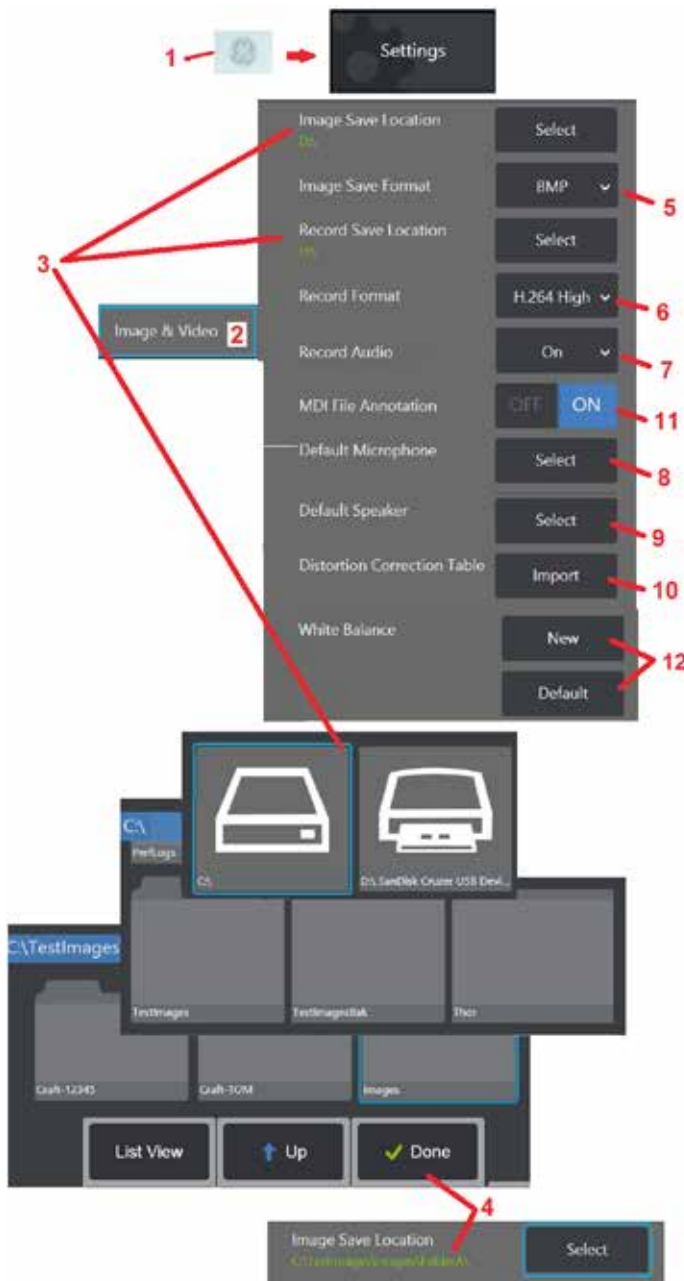
## Mapping the Network Drive and Sharing Folders

**9** – If you choose to give the Visual iQ's **File Manager** access to a folder on a network-connected computer, click on **Setup** (see above) to open the network-mapping process shown here. Next, select **Done** to confirm that the network connected PC has at least one folder identified for sharing.

**10** – Enter the *drive letter* you wish to assign (in the Visual iQ's File Manager) to the shared folder, then input the complete path to the folder on the network-connected PC. Following is an example of a complete path to insert in the Folder line: **\\Device Name\TestShare Folder**. When the folder path and username/password (assuming it is a password protected network) have been entered, click **Done**.

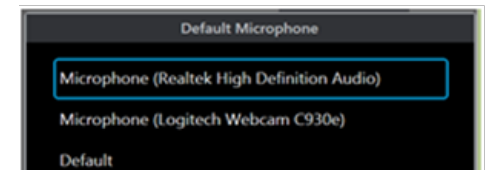
**11** – To share one of the Visual iQ's folders with a network-connected computer, click on **Setup** (see above) to open the file-selecting process. The path in the blue bar shown here identifies the folder that will be shared. Next, select **Done** to display the Warning statement listing the folder that will be shared, and select **Done** again to confirm that the identified folder is the one you wish to share with a network-connected PC.

**12** – Set the **USB Slave Mode** to **Mass Storage** or **Disable**. When set to **Mass Storage**, a connected computer can work directly with files stored on the Visual iQ's hard drive for file management purposes. In this state, the iQ will not perform inspection functions. When file management functions are complete, change setting to **Disable** to return inspection functionality.



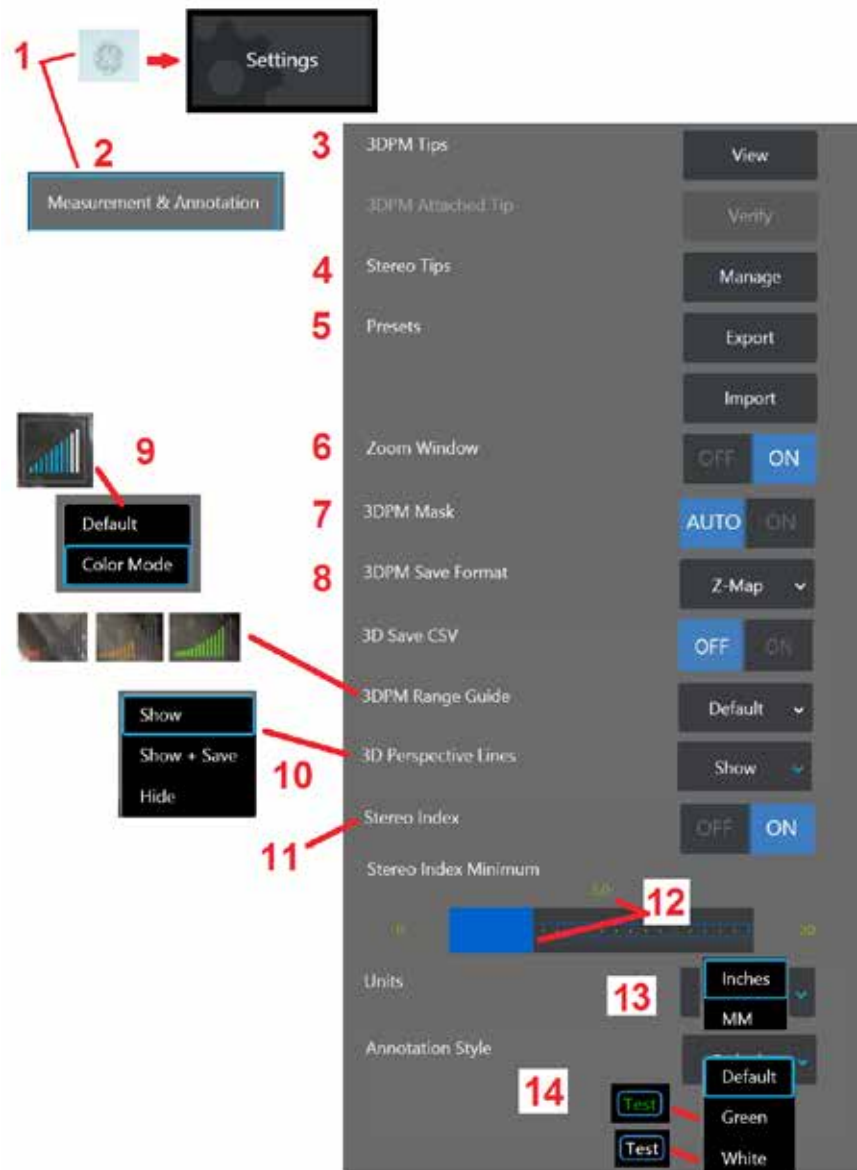
## Image & Video Setup

- 1 – Tap the on-screen **GE Logo** (or press ) to open the **Global Menu**, then open the **Settings Menu**.
  - 2 – Select to change **Image** and **Video** related settings and defaults.
  - 3 – Follow the procedure shown here to change either the **Image Save Location** or **Video Save Location**. These represent the two locations where quick-save images or videos are automatically stored. In the example shown here, these locations are both initially set to the **D:** drive. Press the **Select** soft key and then choose the desired directory path. When the desired storage location is opened, select the **Done** soft key to complete the process.  
*Note: The DVD drive may not serve as either the default or alternative saving location. Files must first be saved in a directory located in the instrument's memory or on a connected USB storage device. Files can later be copied and pasted to optical media in an attached DVD drive.*
  - 4 – Using the process outlined above, the default **Image Save Location** is changed to C:\TestImages\Images\FolderA. This is the location where quick-saved images are stored ([Click to learn more about Saving Images](#)).
  - 5 – Choose either **BMP** or **JPEG** as the default image file type.
  - 6 – Set the video recording format to either **H.264 High** or **H.264 Low**. ([Click for Working with Video](#)).
  - 7 – Determines if the microphone icon (at right) appears in the display's bottom right corner during video recording. When displayed, tap the icon to mute or unmute the recording of sound along with video. ([Click here to learn more about muting or turning sound ON when recording live video](#)).
  - 8 – When set to **Default**, the system will normally recognize the connected **Microphone**. Alternatively, choose a microphone from those available (choices are only those devices already connected to the Visual iQ or paired via Bluetooth).
  - 9 – When set to **Default**, the system will normally recognize the connected **Speaker**. Alternatively, choose a speaker from those available (choices are only those devices that are already connected to the Visual iQ or paired via Bluetooth).
  - 10 – Should a not-yet-defined tip configuration require an alternative **Distortion Correction Table**, Contact GE Technical Support. A table supplied by GE Technical Support will include instructions on how to **Import** the file.
  - 11 – When set to **OFF**, the menu-directed inspection stage name is not saved in the image but will still appear during the MDI process.
- ### Executing a White Balance
- A white balance corrects the color so that white appears white despite any slight hues that may exist under the lighting conditions present when performed.
- 12 – Select **New** and follow the prompts or select **Default** to restore factory color settings.

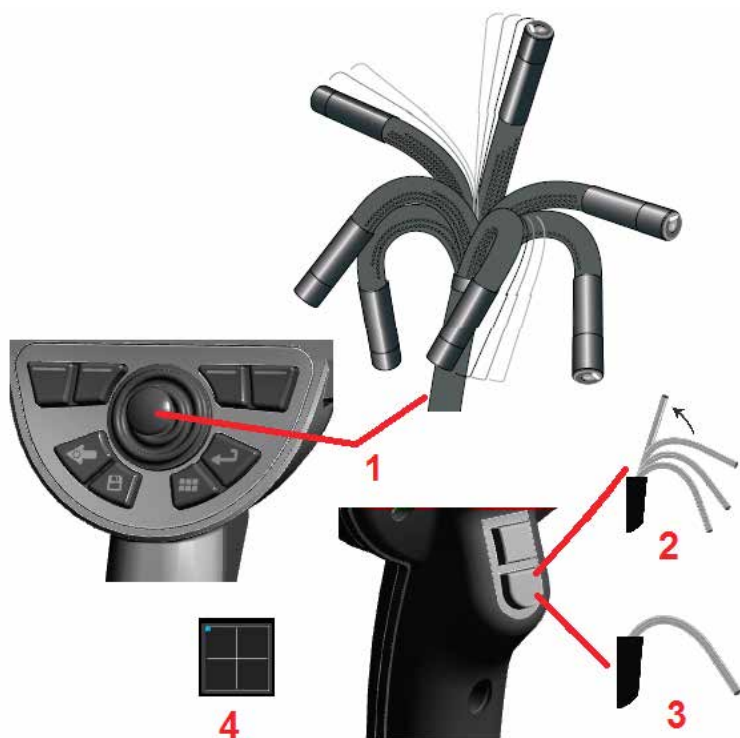




# Measurement & Annotation Setup



- 1** – Tap the lower-left corner of the display (typically contains a **GE Logo**) or (or press the hard key) at any time to open the **Global Menu**, which provides access to the **Settings Menu**.
- 2** – Select to alter the **Measurement and Annotation**-specific settings shown here.
- 3** – View the list of 3DPM Tips already calibrated for use with the attached probe.
- 4** – Select to view a list of Stereo Tips already-calibrated for use with the attached probe. The **Add Tip** and **Edit List** options are not intended for general use. Deleting a tip through the **Edit List** option will permanently remove that tip's calibration data requiring the probe and tip to be returned to an authorized GE Inspection Technologies service center for re-calibration.
- 5** – Save **Preset** Annotation (notes) to an external storage device or **Import** preset notes to the instrument from an external device.
- 6** – Displays or removes the Zoom Window (used for detailed cursor placement during measurement).
- 7** – Select **AUTO** to show the 3DPM red/yellow un-measurable pixel mask only when a cursor is placed on a red/yellow pixel. Select **ON** to always show the pixel mask when measuring.
- 8** – Select **Z-Map** for most usage. **P-Map** images contain additional data and may be requested by GE Technical Support to aid in troubleshooting.
- 9** – Determine the type of **Range Guide** to display during 3DPM measurement. As the tip-to-target distance decreases, the **3DPM Range Guide** displays an increasing number of illuminated bars. In **Default** mode, the illuminated bars are all blue. In **Color Mode**, the bar color transitions from red, when few bars are illuminated, to green, when most of the bars are illuminated. [Click here to learn more about making 3DPM measurements and the Range Guide.](#)
- 10** – Displays four dotted lines in the full-image point cloud view. These lines represent field of view, providing the user with a better sense of probe orientation relative to the viewed surface. When using a measurement plane in conjunction with a **Point-to-Line**, **Area**, or **Depth** measurement type, an **Edge View Angle** is also included in both full-image and measurement-image point cloud views. These lines may be **Hidden**, **Shown** in the point cloud view during measurement or **Shown and Saved** along with the saved measurement image.
- 11** – Controls the display of the Stereo Index, which appears during Stereo Measurement. [Click here for more about Stereo Index.](#)
- 12** – Sets a threshold value for the Stereo Index below which the index flashes during Stereo Measurement. This may be used to warn the user of low-index measurements where the accuracy may be reduced.
- 13** – Specify the unit of measurement as **Inches** or **Millimeters**.
- 14** – Annotation may be added to any frozen or recalled image. Select the **Annotation Style** to change the color of the letters displayed. Text colors available include black (**Default**), **Green**, and **White**.



## Capturing and Adjusting Images


### Steering the Probe

When you are viewing a live image, you can aim the probe's camera by controlling its bending neck.

**1 – Steering the Bending Neck:** While viewing a live image, move the joystick toward the feature you want to see. The bending neck articulates so that the probe tip moves in that same direction.

**2 – Straightening the Bending Neck:** Long press this button to HOME or straighten the bending neck for safe withdrawal and storage of the insertion tube.

**3 – Setting the Steering Mode:** Short press this button to choose between **Steer** or **Steer and Stay** mode. In either mode, the bending neck articulates to follow the joystick motion. They differ in how they behave after the joystick is released ([click here to learn how to setup the sensitivity of either mode](#)). **Steer** mode allows the bending neck to drift towards a straight position when the joystick is released. **Steer and Stay** mode **holds** the bending neck in its articulated position when the joystick is released. If you move

the joystick while in **Steer-and-Stay** mode, the bending neck articulates. When you stop moving the joystick, the bending neck stays in the new position. This  icon appears when in **Steer and Stay** mode.

**Note:** Connecting a Bluetooth or USB-wired keyboard allows for remote control of iQ functions and probe articulation. See [Appendix O](#) for a list of function key and key-press combinations equivalent to iQ button and joystick operations.

**4 – Tip Map.** This on-screen icon indicates the relative positions of the steering motors. When the illuminated dot appears in the center of the crosshairs, the motors are centered. The bending neck position generally follows the motor positions but is affected by the shape of the insertion tube and other mechanical effects. The further the dot appears from the center of the icon, the more the bending neck is articulated. Depending on the rotation of the insertion tube and camera, the viewing area may or may not align with the direction indicated on the **Tip Map**.




### Guiding the Insertion Tube Into the Inspection Area

With the desired optical tip installed, guide the insertion tube into the inspection area. Use your hands to push the tube until it reaches an area you want to inspect. Twist the insertion tube gently to bring the desired scene into view. Accessories are available to make it easier to maneuver the tube:

- **Rigidizers:** Rigid or semi-flexible guide tubes (available in different lengths) keep the tube supported as you insert it or allows the tube to span a recess.
- **Grippers:** Cylindrical handles that slide over the insertion tube to make it easier to control. Grippers are threaded to connect to rigidizers and to access port couplers.

### Temperature Sensor Warnings

When excessive temperature is detected, the applicable icon displays in the status bar, and one of the warning messages listed below appears across the top of the display screen:


- **Probe tip temperature has entered the WARNING Zone**—this message displays in an orange banner when tip temperature exceeds approximately 95°C and  appears in the status bar.
- **Probe tip temperature has entered the CRITICAL Zone**—this message displays in a red banner when tip temperature exceeds approximately 100°C and  appears in the status bar.
- **System is overheated, system shut down initiated**—this message displays in a red banner when internal temperatures exceed limits. Shutdown automatically initiates and  appears in the status bar.


When either the CRITICAL Zone or System Overheat warning appears, take immediate action to lower the temperature to which the indicated component is exposed.

## Freezing the Image

Freeze an image to temporarily capture it for review or adjustment. Moving the joystick in a frozen view does not articulate the probe tip.

**1** – Briefly press either of these keys or tap anywhere on a live on-screen image to freeze the display. The **FF** icon appears in the upper left corner of the display and the soft key menu opens, allowing for adjustment of the frozen image. Reverse this process (or

press ) to unfreeze the display.

**2** – Tap (or press and hold the  key) to toggle between the upper and lower soft key menus. Double tapping in this location hides or displays the soft keys and status bar.

**3** – Select any one of up to four **Views** available when a 2D image is frozen or six **Views** when a 3DPM image is recalled (click here to learn more about each view).

**4** – Add notes or arrows to the frozen image ([Click here to learn more about annotating images](#)).

**5** – Select and adjust four image transformation settings including **Brightness**, **Distortion Correction**, **Invert**, and **Inverse+**. ([Click here to learn about image settings](#)).

**6** – When a stereo tip is calibrated to the system, **Stereo** appears in white text. Press to perform stereo measurement. If no stereo tips are calibrated, **Stereo** appears in gray and may not be selected. ([Click here to learn more about Stereo Measurements](#)).

**7** – Minimize the image to view unobscured by soft keys and status bar.

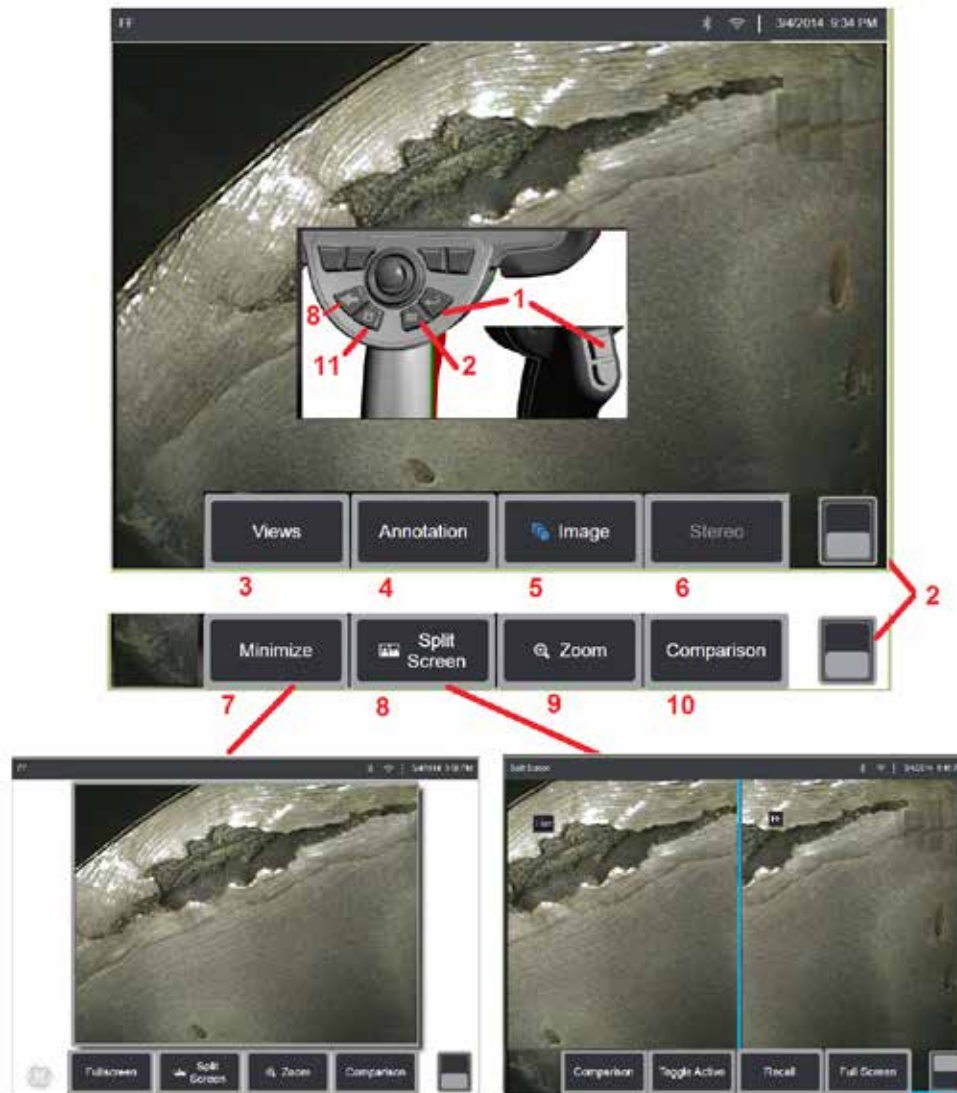
**8** – Opens a Split Screen showing both frozen and live images. Press **Full Screen** to return to single screen view. ([Click here to learn about working with Split Screens](#)).

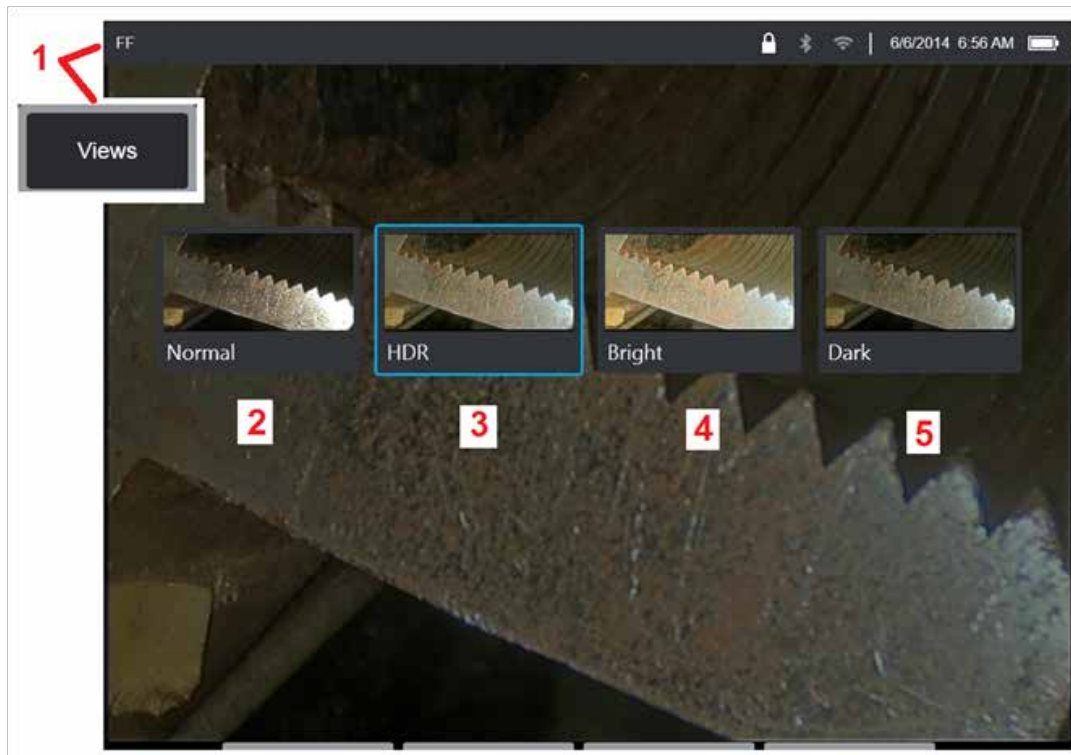
**9** – Zoom in or enlarge a portion of the frozen image ([Click here to learn about the Zoom feature](#)).

**Note:** If you zoom in on a frozen image and then move the joystick or drag the image with your finger, the image pans as the system electronically reviews the entire image.

**10** – Measure features of the frozen image ([Click here to learn about Comparison measurements](#)).

**11** – Press or press-and-hold to Save the frozen image ([Click here to learn about the Save feature](#)). Double press this key to save a **Screenshot** of the display screen.





## Selecting a View

When a 2D image is frozen (or a 3DPM image is recalled), the user can select from various Views as described below.

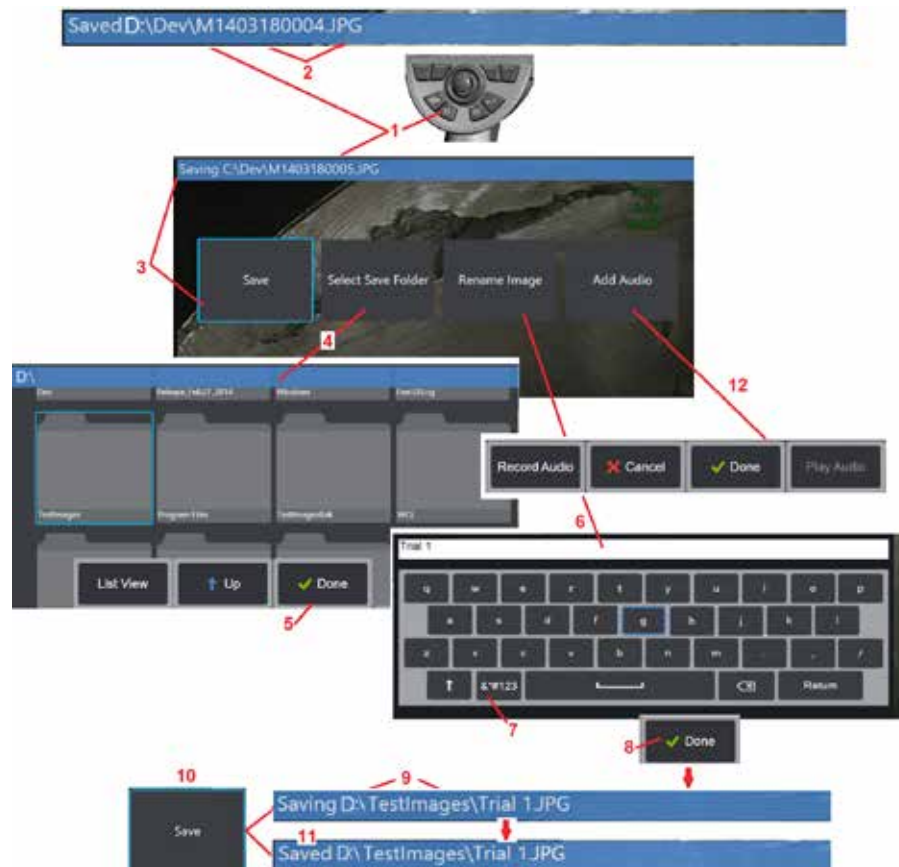
- 1** – Anytime an image is frozen, select to choose from all available **View** options.
- 2** – Displays a normal dynamic range image created by applying **Adaptive Noise Reduction (ANR)** processing to live video frames prior to the freeze request.
- 3** – **HDR** is a **high dynamic range** image generated by combining normal brightness ANR images captured before the freeze request with images of different brightness levels captured after the freeze request. This reduces the glare (number of saturated pixels) and increases brightness in dark areas.
- 4** – Displays a view similar to HDR but gives up some detail in bright areas to further brighten dark areas.
- 5** – Displays a view similar to HDR but gives up brightness in dark areas to show more detail in bright areas.

***Note:** To optimize the quality of all captured images, hold the probe tip still at the time of capture. Increasing the live image brightness prior to image capture will improve the quality of the "HDR" and "Bright" images in darker areas.*

***Note:** Point Cloud and Depth Profile views are only available when working with 3DPM and 3DST images. [Click here to learn more about working with these views.](#)*

***Note:** Once an image is saved with any one of these View options active, only that option and Normal are available when the saved image is recalled.*





## Saving Image Files

Image files can be stored in the Visual IQ or a detachable device. The **Quick-Save** feature stores a file with a default name and file type in a default directory ([Click here to learn more about setting default file names, types, and directories](#)). Alternatively, use the **Save Options Menu**.

**1** – Perform a short press of this hard key to **Quick Save** the displayed image in the default directory. A long press of this key opens the **Save Options Menu**. Double pressing this key saves a **Screenshot** of the display screen.

*Note: Screenshots are BMP image files of the display screen, do not contain RVI data of any type, are stored in an automatically created subfolder titled "Screenshots," and are assigned the auto-generated image file name but identified with the addition of the letters "ss."*

*Note: The DVD drive may not serve as either the default or alternative saving location. Files must first be saved in a directory located in the instrument's memory or on a connected USB storage device. Files can later be copied and pasted to optical media in an attached DVD drive.*

**2** – At all times, the intended saving location (in this case the Dev directory located on the D drive) is listed here. After a file is stored, the status bar at the top of the screen indicates **"Saved."** The file name (described below) and format are also listed.

*Note: Each time files are pasted to the DVD drive, the optical media is auto-ejected to avoid loss of data.*

**3** – While in the process of assigning an alternative name or destination for the image file, the status bar at the top of the screen indicates **"Saving."**

**4** – Choose an alternative directory into which the file will be stored.

*Note: Tap and open the target folder*

**5** – Tap to complete the target directory selection.

**6** – Select to **Rename** the file prior to saving. The virtual keyboard opens.

**7** – Select to choose from numeric characters or symbols.

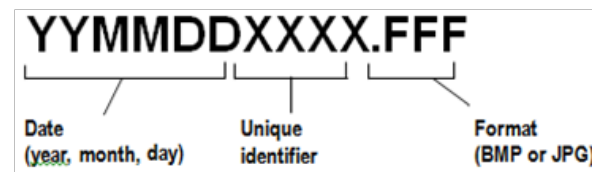
**8** – Tap after typing the desired name.

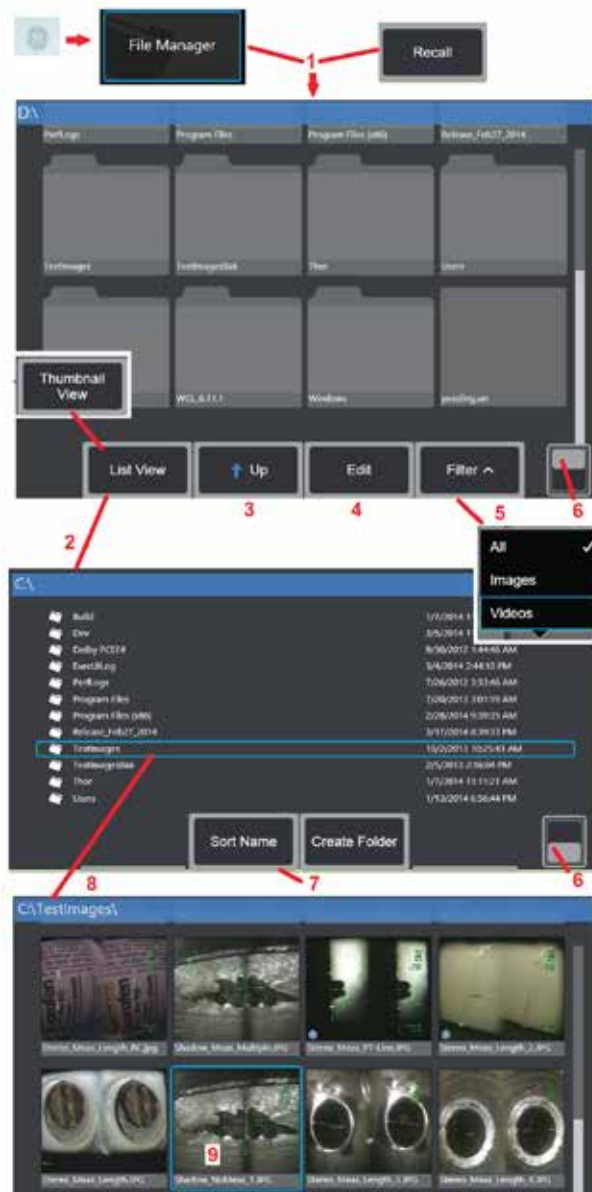
**9** – The status bar now indicates the new target directory (in this case, **TestImages**) and the new file name (**Trial 1**).

**10** – Tap to complete the saving process.

**11** – The status bar now indicates that the file has been **"Saved."**

**12** – Add audio comments to the file **before completing the saving process** ([Click here to learn more about recording audio comments](#)).





## Working with a Recalled Image

Image and video files can be stored in the Visual iQ or a detachable device. The **Recall** feature allows these stored files to be displayed, measured, and annotated. Follow these steps to locate and **Recall** a stored file:

**1** – **Recall** a stored image or video by tapping the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then select **File Manager**.

**Note:** Selecting the **Recall** soft key (when enabled) automatically opens the last saved image (provided one has been saved since the iQ was last powered ON). Moving the joystick (or dragging the display with your finger) left or right recalls other images stored in the same folder as the originally recalled image.

**2** – Controls the **File Manager's** appearance (both **Thumbnail** and **List Views** are shown here).

**3** – Select to navigate to the next higher directory within the **File Manager**.

**4** – Select to **Copy**, **Rename**, and otherwise **Edit** stored files ([Click here to learn more about the file Edit feature](#)).

**5** – Choose which file types to display.

**6** – Tap to switch between the **Soft Key Bar's** top and bottom row. Double tapping in this location hides or displays the soft keys and status bar.

**7** – Determine the order in which folders or files are listed (by date or alphabetical order).

**8** – Tap screen to select the folder to open.

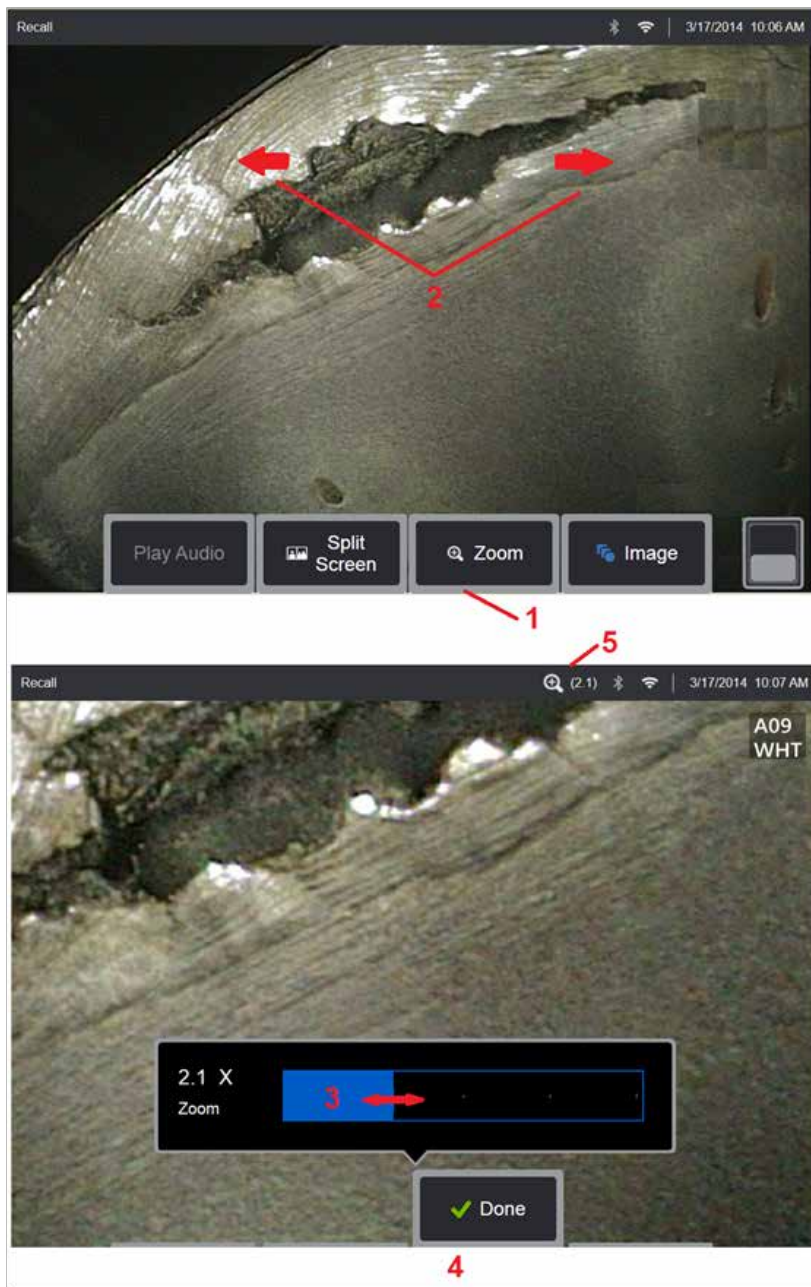
**9** – Tap screen to select the file to **Recall**.

**10** – Once an image is recalled, various actions can be taken (see soft key menus below). Click on any of the following to learn more about the function:

- Select the displayed View
- Annotate by adding text or arrows
- Measure image features
- Play recorded audio
- Open a Split Screen to display any two images (live, frozen, or recalled)
- Use Zoom to magnify
- Adjust the Image




**11** – Press to open an onscreen list of the displayed file's **Detailed** properties.



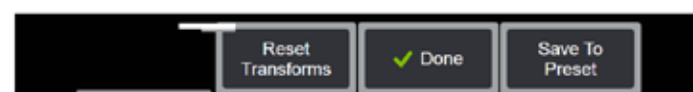
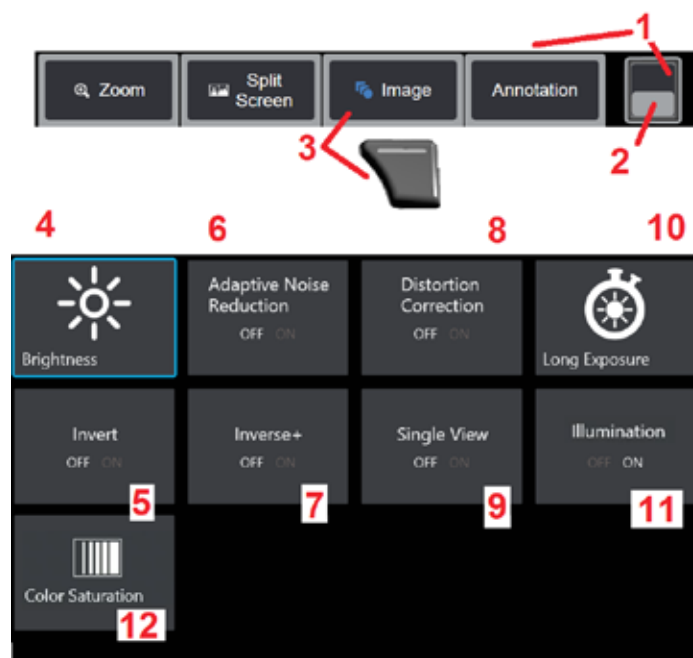
## Zoom to Magnify

The Zoom feature magnifies the view of live, frozen, and recalled images. Because the zooming process is digital, pixilation increases as the image is magnified.

**Note: The Visual iQ offers two equivalent zooming methods.**

- 1** – Select this soft key to launch the Zoom control bar.
- 2** – Position one finger on either side of a feature, then slide fingers apart to increase magnification (Zooms IN). Moving fingers towards each other decreases magnification (Zooms OUT).
- 3** – Touch and slide this bar left or right (or move it with the Joystick) to decrease or increase the amount of image magnification. Repeat this process to return to a unmagnified image (Zoom value of 1X).
- 4** – Select when the image magnification process is complete.
- 5** – When the image is zoomed, the  icon appears in the display's status bar along with a value representing the amount of image magnification (2.1 times is shown here).

**Note: Whenever a frozen or recalled image is magnified with the Zoom feature, simply drag your finger across the display screen or use the Joystick to view off-screen portions of the magnified image.**




## Image Transformation Settings

These settings, accessed by selecting the **Image Menu**, alter the appearance of live images. (Some of these settings also affect frozen or recalled images.) At any time, the values assigned to these eight transformation settings can be saved as a user-named **Preset**. When recalled, all transformation settings will revert to these “preset” values. [\(Click here to learn about working with Preset Image Transformation Settings\)](#)


- 1** – Double tap this switch to hide or display the **Soft Key Bar**.
- 2** – Tap to switch between the **Soft Key Bar’s** top and bottom row.
- 3** – Tap on-screen **Image** button or press the corresponding key to display the **Image Menu**.
- 4** – Tap the on-screen **Brightness** icon to adjust the displayed image. The adjustment bar shown will then appear – drag it to the left or right. You can adjust the brightness of live, frozen, and recalled images as well as recorded video. The brightness level selected when an image is saved will be maintained when the image is recalled.

**Note:** When viewing live images, adjusting the brightness means controlling exposure time and camera gain. When viewing still images or recorded video, adjusting the brightness means controlling digital gain.


- 5** – Tap on-screen **Invert** icon to turn **ON** or **OFF**. When turned ON,  appears at the top of the display. This feature horizontally flips any image.

**Note:** This feature allows you to “correct” images when using a side-view optical tip, since the prism contained in these tips would otherwise show an inverted image.



**6** – Tap to turn **Adaptive Noise Reduction (ANR) ON** or **OFF**. ANR works to reduce the amount of noise (which appears as a grainy image) visible when the probe is positioned in a dark area. The ANR setting (ON or OFF) applies only to live video. **ANR** is automatically applied to reduce noise in all frozen and saved images, even when the ANR setting is set to OFF. When turned ON,  appears at the top of the display.

**Note: Keep the probe still when capturing an image. Noise increases with probe movement.**

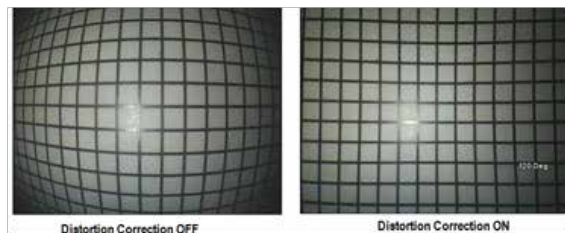
**7** – Tap to turn **Inverse+** either **ON** or **OFF**. When turned ON,  appears at the top of the display. The Inverse+ function enhances image contrast – often making subtle details more visible in low light or poor contrast images. Turning **Inverse+** ON reverses the image's dark and light areas, much the same as a photographic negative.



**8** – Tap to turn **Distortion Correction** either **ON** or **OFF**. The **Distortion Correction** function corrects the wide-angle edge distortion that occurs when using optical tips with various angle fields of view

**Note: When saving a corrected image, the face of the image will be labeled 120 Deg.**

**Note: When viewing a corrected image, the selected tip field of view (FOV) angle is overlaid in the lower right corner.**



**9** – Tap to turn the **Single View** feature **ON** or **OFF**. **Single View** is useful while positioning a stereo optical tip. This feature makes it easier to navigate the camera by temporarily eliminating the second image.

**10** – Tap the on-screen **Long Exposure** icon to **brighten live images** by increasing the camera's maximum exposure time. **Exposure settings can vary from 1X to 600X.**


**Note: The longer the exposure, the greater the risk of blurring the image. Keep the probe tip as still as possible when capturing an image with a long exposure.**

**11** – Tap to turn the illumination LED ON or OFF

**12** – Tap the on-screen **Color Saturation** button to adjust the amount of color in the image. While the adjustment can only be made while viewing live video, the adjusted color is preserved in subsequently frozen and saved images. This may be useful when assessing for heat-related conditions indicated by subtle color changes.

**13** – Tap on-screen DONE button or press the corresponding key to close the Image Menu and return to the Soft Key Bar. Any changes to image transformation settings will remain until manually modified or otherwise altered by recalling a stored Preset.

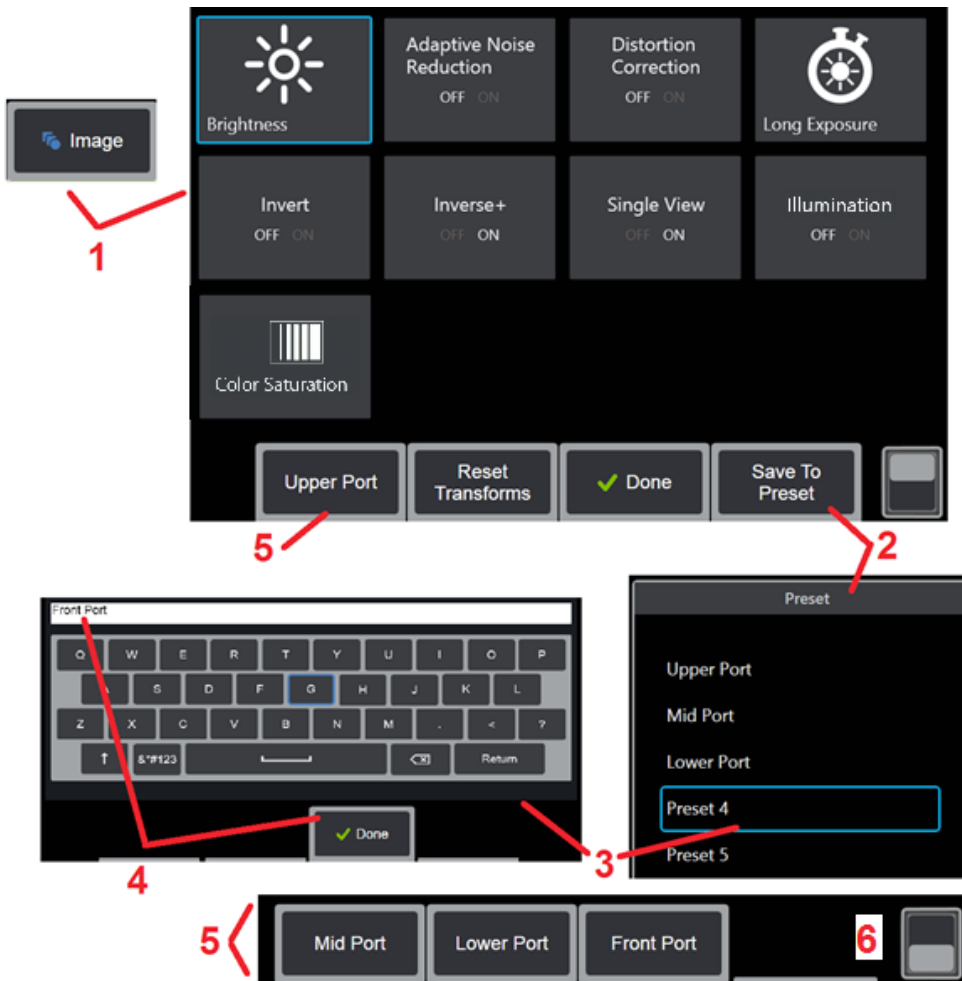


Pressing  while viewing live video turns off all transforms.

**Note: Any changes made to image transformation settings are lost during power down.**

**14** – Tap on-screen Preset button or press the corresponding key to create and name a Preset containing the values currently assigned to each of the eight Image Transformation settings. Recalling the Preset later allows you to automatically change all Image Transformation settings to the stored values. ([Click here to learn about Working with Preset Image Transformation Settings](#)).

**15** – Tap on-screen **Reset Transforms** to restore the factory default values for each of these eight settings.



## Working with Preset Image Transformation Settings

Values assigned to the image transformation settings can be saved as a user-named **Preset**. When recalled, all transformation settings will revert to the values assigned when the **Preset** was created. Each user-named **Preset** appears as a soft key in the **Image Menu**. To load a **Preset**, simply select its soft key or press the corresponding button.

**1** – Tap the on-screen **Image** button or press the corresponding key to display the **Image Menu**, which contains the eight image transformation settings. Adjust settings as needed.

**2** – To save the image transformation settings in a user-named **Preset**, select **Save to Preset**. The **Preset List** will open.

**3** – Tap to select any one of the five **Presets**. The **virtual keyboard** will open, allowing you to name the **Preset**.

**4** – After entering a name for the **Preset**, select **Done**.

**5** – The user-named **Presets** appear as soft keys in the **Image Menu**. Select any of these to load the settings stored in the corresponding **Preset**.

**6** – Tap here to toggle between the upper and lower **Soft Key Bars**.

**Note:** Presets are stored only for the profile that is logged in at the time they are created.

## Working with a Split Screen

A split screen displays two images side-by-side in any combination of live, frozen, or recalled. Since half-screen still images are cropped, dragging a finger across the display or moving the joystick allows you to pan side-to-side within the image.

**1** – Press at any time to launch the Split Screen feature. One half of the screen will initially show a live image, the other shows a frozen version of the image that appeared when **Split Screen** was selected.



**Note:** To exit Split Screen mode, press  until a full-screen reappears.

**2** – Each displayed image will be identified as either **Live**, **Frozen (FF)**, or **Recalled**.

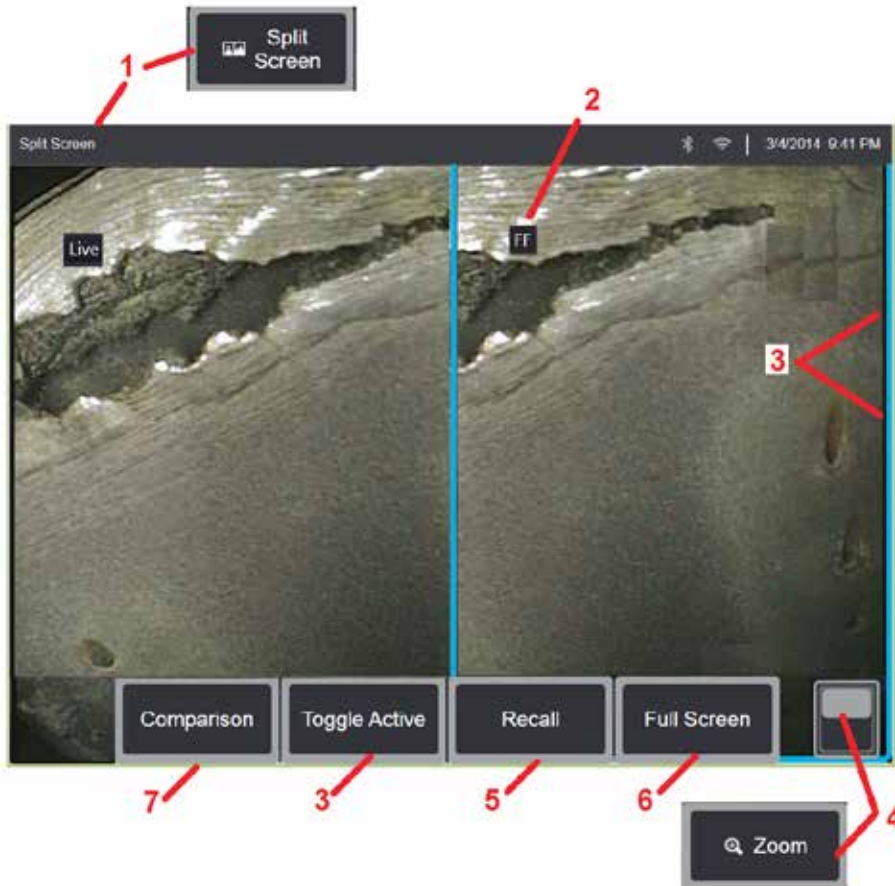
**3** – Select which image is active by touching either side of the split screen, or by selecting this soft key, or moving the joystick left or right. Only one image is active at a time, as indicated by the blue outline around the active image.

**4** – Change the magnification of the active image by zooming IN or OUT ([Click here to learn more about the Zoom feature](#)).

**5** – Select to **Recall** a stored image into whichever side of the display is currently active ([Click here to work with Recalled images](#)).

**6** – Temporarily displays the active image as a full screen. This action **DOES NOT** cause the display to exit **Split Screen** mode.

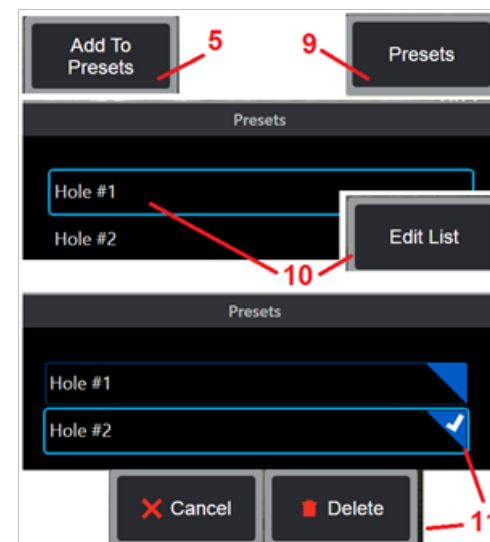
**7** – Measurement mode available for still images. This soft key is labeled with the most advanced measurement mode (3DPM, Stereo, or Comparison) available for the active still image. It allows measurement to be entered with the active image. Exiting from measurement will return to the current Split Screen view. ([Click here to learn more about Comparison measurement mode](#)).

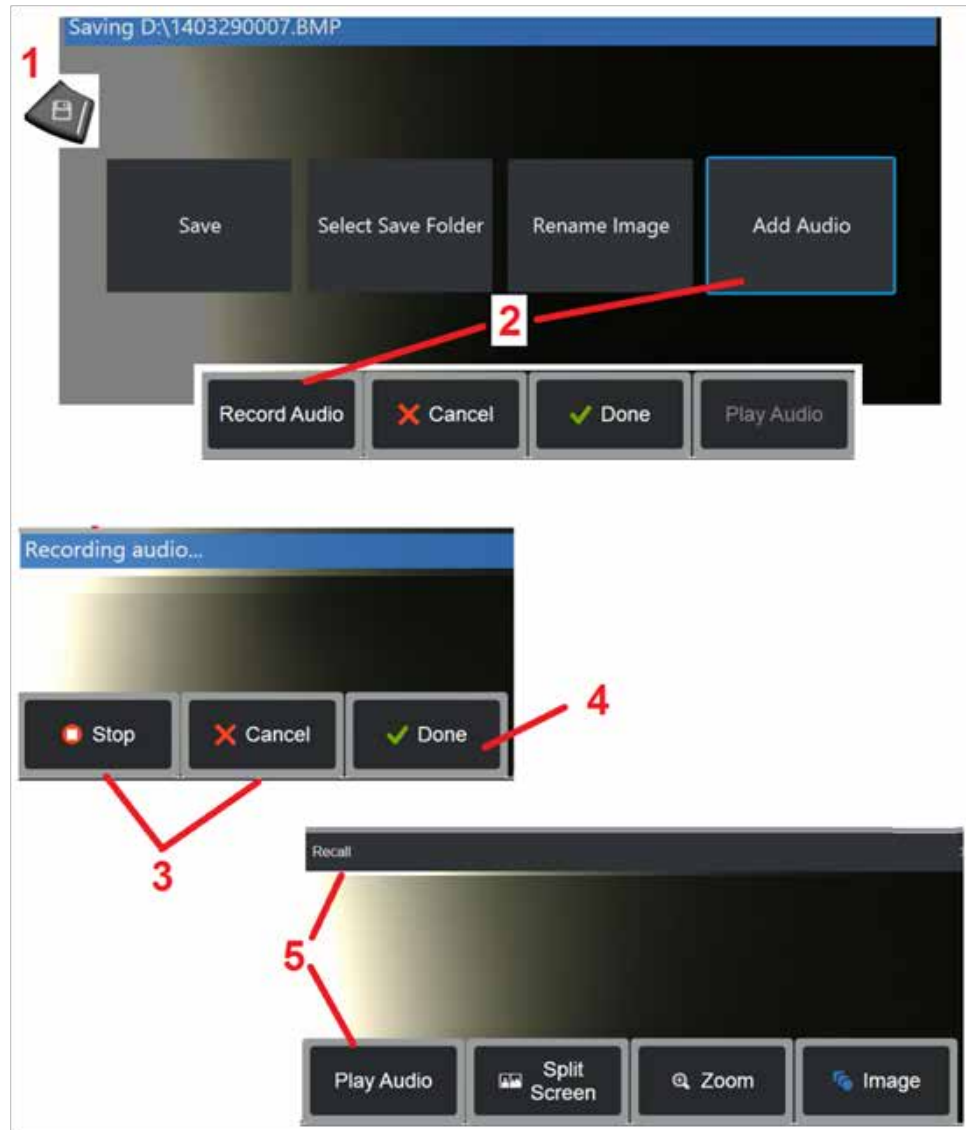


## Annotating with Text and Arrows

Annotating an image means adding text or arrows to point out areas of interest: cracks, indications, etc. You can annotate live, frozen, and recalled images.

- 1 – Select to launch the **Annotation** feature.
  - 2 – Tap to switch between the **Soft Key Bar's** top and bottom row. Double tapping in this location hides or displays the soft keys and status bar.
  - 3 – Adding annotation begins by selecting **Text** or **Arrow**.
  - 4 – Selecting **Text** opens the **Virtual Keyboard**. Enter the desired note. **Note: Adjusting the color of annotation may make it more visible against a specific image. [Click here to learn how to change the color of annotation text.](#)**
  - 5 – Select to add the entered note to a list of up to 100 **Preset** notes, which can be repeatedly used without typing.
  - 6 – Select **Done** when finished typing the note, which will appear on the image surrounded by a blue box indicating it is selected. While in this selected state, the note can be moved (by dragging with your finger or using the joystick), **Edited**, or **Deleted**. Select **Done** again to de-select the note.
  - 7 – A selected **Arrow** (added in the same way as a note) appears with a ball at one end. Move the arrow around the display by dragging with your finger (near the arrowhead) or using the joystick. The arrow may also be rotated by moving the ball with your finger or with the **Rotate** soft key.
  - 8 – Select **Done** to de-select the arrow.
- Note: Any note or arrow can be selected by simply tapping its position on the display.**
- 9 – Opens the list of user-created **Preset** notes (annotation). **Recents** shows all recently typed notes, including presets.
  - 10 – Once open, select and **Add a Preset** note or select it for **Editing**.
  - 11 – Tap in this corner (white check appears) to identify a note for deletion.



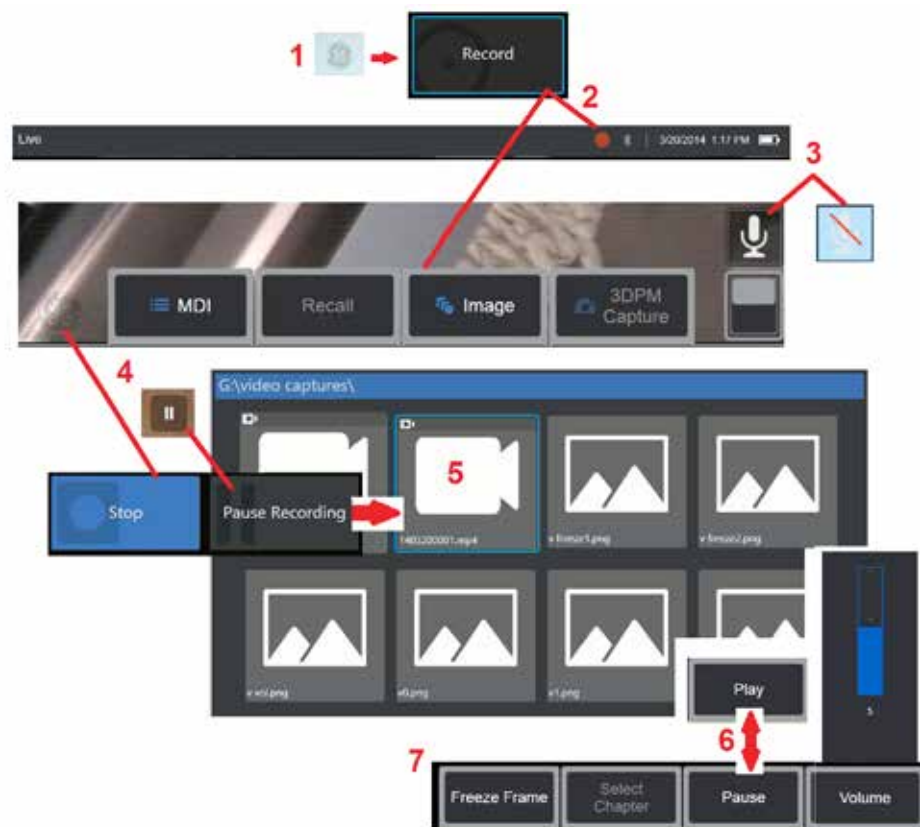


## Adding Audio Notes to an Image

During the process of saving an image, audio notes can be added provided a microphone is first attached to the Visual IQ.

- 1** – Long press the **Save** hard key to begin the image saving process.
- 2** – Select **Add Audio** to begin the audio recording process. Be sure to have first connected a microphone ([click here to specify the microphone attached and other Image and Video settings](#)).
- 3** – Select either control to momentarily **Stop** or permanently **Cancel** the audio recording process.
- 4** – Select to complete the audio recording process. The audio notes are now part of the stored image file. You can now play or re-record the audio notes.
- 5** – After recalling a stored image, the recorded audio notes can be played at any time (**Note:** when an image is recalled, the **Play Audio** soft key may be located in the lower soft key row).





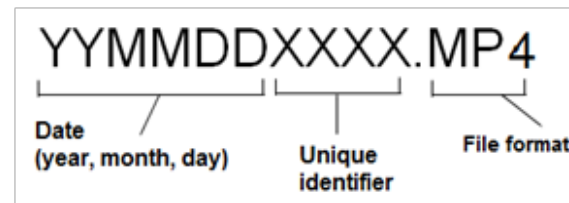
## Recording Live Video

**1** – Tap the lower-left corner of the display (typically contains a **GE Logo**) at any time to open the **Global Menu**, which provides access to the video **Record** button.

**2** – Select to begin recording video in the user-selected format ([click here to learn about configuring Video Settings](#)). A red circle flashes at the top of the screen throughout the video recording process. Note that the soft keys shown here (and all other on-screen features) will appear in the video recording. Double-tap the soft key bar's toggle switch to move these buttons off the screen if you do not wish to include them in the recorded video.

**3** – Tap to mute or turn on sound recording. Sound recording will only occur (**and this icon will only appear**) if a microphone is attached to the Visual IQ and the system is properly configured. [Click here to learn more about configuring Video Settings](#).

**4** – Tap the lower-left corner of the display and select either the video **Pause** or **Stop** buttons. Selecting **Pause** (or tapping the on-screen pause control) allows you to restart the same recording. Selecting **Stop** automatically saves the video file with a default name (see description) in the user-defined default folder. Once tapped, the on-screen pause control becomes a play control, which can be tapped to continue recording. Press-and-hold either the pause or play on-screen to stop the recording process. [Click here to learn Video Settings, including selecting the default file-saving location](#).



## Working with Video

Any time during your inspection you can record video “in the background” while doing other tasks, such as comparing images on a split screen, taking measurements, or managing files and folders. When you record video, the system saves everything that appears on the display, as well as background sounds and comments made near the microphone (unless you turn off the audio). You can record video onto the internal drive or any other removable storage device.

	4GB	8GB	16GB	32GB
MViQ MPEG4 High	111 min	222 min	444 min	888min
	1.85 hours	3.7 hours	7.4 hours	14.8 hours
MViQ MPEG4 Low	370 min	740 min	1480 min	2960 min
	6.16 hours	12.33 hours	24.66 hrs.	49.33 hours

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## Working with a Recalled Video

**5** – To recall a saved video file, navigate to the saved file via the **File Manager**. Select the video (which will have an **mp4** file extension). The video will automatically replay.

**6** – These soft keys control the video while it is playing. Use the joystick to rewind or fast-forward the video.

### Capturing a Still Image from Video

**7** – Click here to freeze the video action at any time. Once frozen, the screen image can be saved.

## Using External Video

To use external video, simply connect the external video source to the capture device. Then connect the capture device to an MViQ. The recommended, StarTech USB3HDCAP USB 3.0 video capture device supports HDMI, DVI, VGA, S-Video, Component, and Composite sources. Once connected, external video will be used in place of probe video anytime the video capture device is connected.

## Measuring Features and Indications

### About Measuring

The Visual iQ allows you to measure features or indications either before or after saving an image. You can save up to five measurements per image. In order to perform 3D Phase Measurements (3DPM) or stereo measurements, the image must be captured using a 3DPM, or stereo tip. All saved measurement images can be re-measured on a PC using software from GE's Inspection Technologies. For details, call your local sales representative.

You can save measurement images as JPEGs or bitmaps. You can view these files, including the measurement results, in most .BMP or .JPG viewing applications, such as Windows Paint

#### **Notes:**

*-Measurement results are valid only when taken in air. To measure through liquid, contact GE Inspection Technologies.*

*-GE Inspection Technologies cannot guarantee the accuracy of measurements calculated by the Visual iQ system. Accuracy varies with the application and the operator's ability.*

*-The Visual iQ system can display measurement images that were captured on the Everest XLG3™ and XLGo VideoProbe systems, including their previously captured measurements. However, we do not support re-measurement of images captured with systems other than the Visual iQ.*

## Measurement Types

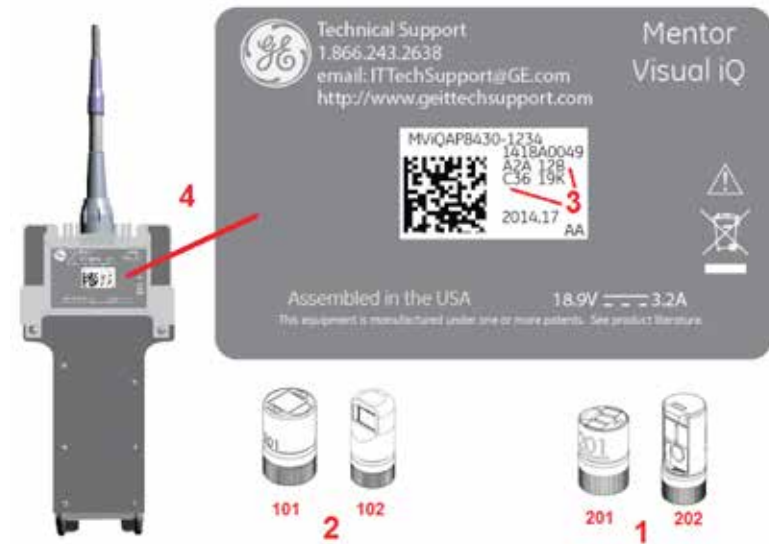
The Visual iQ system supports four types of measurement: 3D Phase, 3D stereo, stereo, and comparison.

Type	Advantages	Considerations
3D Phase	<p><i>Over stereo or comparison measurements:</i></p> <ul style="list-style-type: none"> <li>Optical tip used to view and measure.</li> <li>Range Finder Bar indicates suitability of image for measurement</li> <li>Full screen view.</li> <li>More accurate depth measurements.</li> <li>Cross-section profile view and measure</li> <li>Does not require surface detail</li> <li>The surface need not be perpendicular to the tip.</li> <li>3D point cloud view</li> </ul>	<ul style="list-style-type: none"> <li>The system cannot measure moving parts.</li> <li>Must measure highly reflective surfaces at an angle.</li> <li>Only available on 6.1 mm probes</li> </ul>
3D Stereo	<p><i>Over stereo</i></p> <ul style="list-style-type: none"> <li>Split screen 2D + 3D point cloud view for simpler assessment of measurement quality.</li> <li>Reduced measurement variation.</li> <li>Supports Depth Profile measurements.</li> </ul> <p><i>Over 3D Phase</i></p> <ul style="list-style-type: none"> <li>Less sensitive to probe movement during capture.</li> <li>May perform better on shiny or concave surfaces.</li> <li>Available on all probe diameters.</li> </ul>	<ul style="list-style-type: none"> <li>Same split live image as stereo.</li> <li>Requires surface detail to generate 3D data.</li> <li>May not perform as well as stereo on highly irregular discontinuous surfaces.</li> </ul>
Stereo	<p><i>Over comparison measurements:</i></p> <ul style="list-style-type: none"> <li>More accurate.</li> <li>No known reference is needed.</li> <li>Can measure depth.</li> <li>The surface does not need to be perpendicular to the probe view.</li> </ul>	<p>The system may be unable to position the matching cursors accurately with any of these conditions in the measurement area: insufficient detail, repeating patterns, glare, or smooth, straight lines to measure along.</p> <p>In some cases, you can eliminate the problem by repositioning the probe tip and adjusting the brightness.</p>
Comparison	<p><i>Over stereo measurements:</i></p> <ul style="list-style-type: none"> <li>Use the probe headguard or any other tip optic.</li> <li>Measure with probe tip farther away.</li> <li>Measure large objects.</li> <li>Check approximate size of many items quickly.</li> </ul>	<ul style="list-style-type: none"> <li>Less accurate than stereo measurements.</li> <li>Known references may not be present and may be difficult to deliver to the measurement site.</li> <li>Measurement surface must be nearly perpendicular to the probe view for an accurate measurement.</li> </ul>

## Measurement Tips

**Note:** 3DPM tips are automatically identified by the system. Stereo tips must be manually selected each time a stereo measurement is performed. Although 3D Stereo and stereo use the same stereo tips, they require different factory calibration processes and calibration data. They also utilize different processing to determine 3D coordinates for measurement.

Unlike standard optical tips, 3D PhaseProbe® (1) and StereoProbe® (2) measurement tips are factory-calibrated for use with specific probes and will not measure accurately with other probes. These tips are matched to probes by the serial numbers (3) identified on each optical tip and each probe label (4). Calibration data is stored in memory in the probe, allowing the probe to be used with different handsets.



### Notes:

-To ensure measurement accuracy, verify the tip's accuracy each time it is installed. Refer to [Appendix E](#) for verification procedures.

-The installed tip must be identified before making Stereo measurements. [Click here to view stereo tip identification procedure.](#)

To ensure that no mechanical damage has degraded their accuracy, verify measurement tips each time you use them. See **Verifying Measurement Tips** in [Appendix E](#). To learn which tips are available for each measurement technique, see the **Optical Tip Table** in [Appendix B](#).



# 3D Measurement Types and Special Capabilities

This section specifically addresses cursor placement for each type of 3D Phase and 3D Stereo Measurement.



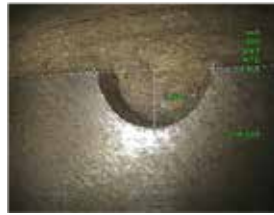
## Description:

Linear (Point-to-Point) measurement



## Cursor Placement:

Place both cursors at the desired locations.



## Description:

The perpendicular distance from a point to a line.



## Cursor Placement:

Place the first two cursors to define a reference line. Place the third cursor at the perpendicular distance you want to measure.



## Description:

The perpendicular distance between a surface and a point above or below it. Used to evaluate changes due to wear, misalignment, and other causes.

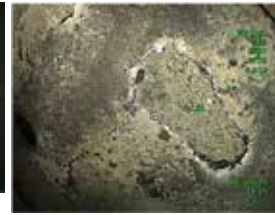


Negative measurements indicate that the point lies below the plane. Positive measurements indicate that it lies above the plane.

## Cursor Placement:

Place the first three cursors to define a reference plane. The **Depth Assist** feature will assess the nearby surface contours and, if found, automatically place fourth cursor at the deepest point, highest point, or blade edge. Check fourth cursor positioning and adjust if needed.

**Note: Depth measurements require the closest possible tip-to-target distance for the greatest accuracy.**




## Description:

The surface area contained within multiple cursors placed around a feature or defect.

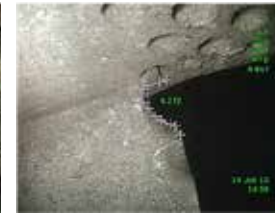


## Cursor Placement:

Place three or more cursors (up to 24) around the edge of the area you want to measure.

When finished, press  twice or select DONE. The area closes.

**Note: Area measurements are computed assuming a relatively flat surface. Area measurements on highly curved or irregular surfaces are less accurate. The point cloud view shows the actual area being computed.**




## Description:

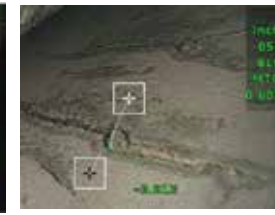
The length of a nonlinear feature or defect.



## Cursor Placement:

Place two or more measurement cursors (up to 24) to create line segments along the feature. When three cursors are used, the 3D angle between the line segments is displayed along with the total length result.

When finished, press  twice or select DONE. The line is finalized.




## Description:

A profile of the perpendicular distances from an area of interest to a specified surface.



## Cursor Placement:

Place one measurement cursor on each side of the area of interest. Both cursors should be completely on flat regions, in the same plane, and should not overlap the indication being measured. The measurement reference plane is determined using all the pixels inside both cursors.

When finished, press  and hold to display the depth profile view.

(See the following section for more detail)

**Note: Depth Profile measurements require the closest possible tip-to-target distance for the greatest accuracy**



## Description:

Gives a depth profile through the deepest or highest point in an area of interest.



## Cursor Placement:

Place two cursors to define a line on the reference surface to one side of the area of interest and a third cursor on the opposite side of the area of interest. The system determines a second line best matching the surface curvature along the first line. It then sweeps depth profiles between the two lines and identifies the profile that includes the deepest or highest point. Can be used on flat surfaces or surfaces with curvature in only one direction such as pipes.

## Notes:

Inserting a Measurement Plane defines a flat 3D plane, which provides a surface onto which measurement cursors are projected. This enables measurement of missing material or edge indications where red pixels would otherwise prevent measurement-cursor placement or 3D data noise would cause inaccurate results. [Click here to learn more about Placing a Measurement Plane.](#)

Once a user-defined Measurement Plane is added to an image, all measurements added before or after the plane was inserted are made with respect to the Measurement Plane.

## Point Cloud View (3DPM and 3D Stereo)

*The point cloud view offers the following advantages:*

- Helps the user visualize the measurement to ensure proper cursor placement and verify 3D data quality.
- Shows location of high and low points to help profile and depth cursor positioning.
- Shows the level of noise relative to indication size. Move the probe tip closer or adjust viewing angle if surface noise bumps appear significant relative to the indication size.
- Shows ripple or waves, which may indicate dirt or oil on the gratings or reflections bouncing off one surface onto another.

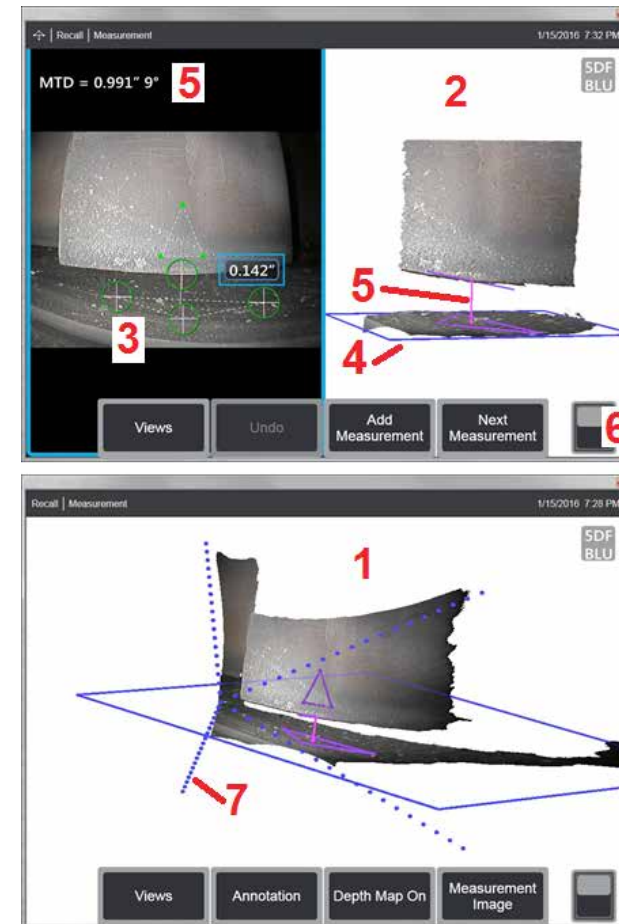
The Visual iQ offers two different point cloud image options: Full Image and Measurement Image, either of which may be viewed full screen or in a split view with the left-hand view containing the 3D Stereo or 3DPM image for simultaneous cursor placement and point cloud inspection. In 3DPM split view, the 2D image may be zoomed and panned using the touch screen.

The following apply to both **Full Image (1)** and **Measurement Image (2)**:

- The cursor positions and the lines between the cursors are shown (3).
- For **Depth Profile** and **Area Depth Profile**, the profile slice along the surface is shown.
- For **Depth**, **Depth Profile**, **Area Depth Profile**, and measurement utilizing a **Measurement Plane**, a blue rectangle in the point cloud view indicates the reference plane position (4).
- When a **Measurement Plane** is used with **Point to Line**, **Area**, or **Depth** measurements, an **Edge View Angle** and **Line (5)** are shown to aid proper view setup.
- Drag a single finger over the touchscreen (or use the joystick) to rotate the point cloud.
- Use two fingers to shift or rotate the point cloud clockwise or counterclockwise.
- Slide two fingers together or apart to increase or decrease the zoom level or select **Zoom**.
- Press **Reset** to return to the default view (second level 6 soft key).

With **Full Image**, the following apply:

- Shows all 3D data and all measurements with the active measurement shown in bold.



- The colored **Depth Map** indicates tip-to-target distance.
- Dotted lines show the corners of the field of view to help visualize tip and surface positions (7). These are controlled by the **3D Perspective Lines** option on the **Measurement and Annotation Settings** panel.

With **Measurement Image**, the following apply:

- Only the active measurement and the 3D data near it are shown.
- With **Depth Map** on, a scale indicates the depth or height relative to the reference plane.

---

## Measurement Plane (3D Phase and 3D Stereo)

A **Measurement Plane** is not a standalone measurement type and gives no result. When used with specific measurement types, the **Measurement Plane** allows cursor placement in red areas where no 3D data is present or where noise in the 3D data may reduce measurement accuracy.

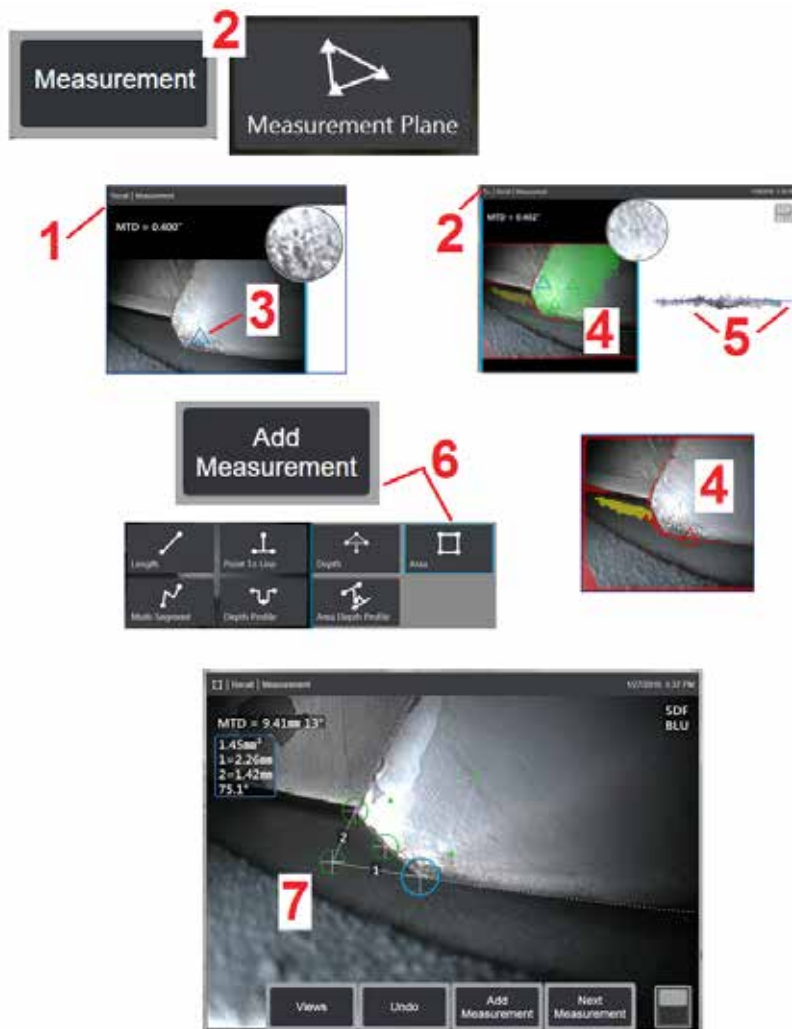
Once placed, a **Measurement Plane** establishes a 3D plane aligned with a flat area on the surface of the viewed object. The plane mathematically extends beyond the edges of the surface over the entire image. The presence of a **Measurement Plane** affects specific measurement types as follows:

- **Length, Point to Line, Multi-Segment, and Area:** All cursors are projected onto the **Measurement Plane**, and the result is computed using the projected positions on the plane.
- **Depth:** The first three cursors select individual surface points as with a normal **Depth** measurement. Only the fourth is projected onto the **Measurement Plane**.
- **Depth Profile:** The **Measurement Plane** is used as the reference plane, so the **Depth Profile** cursors may overlap edges or be in red areas. The resulting dimension shows the height or depth from the **Measurement Plane**. Use only with flat reference surfaces.
- **Area Depth Profile:** Both reference lines are positioned on the **Measurement Plane** allowing them to pass through red areas or surface pits without affecting the profiles taken between the reference lines. The resulting dimension shows the height or depth from the **Measurement Plane**. Use only with flat reference surfaces.

Applications for **Measurement Plane** usage include:

- **Area** measurement of a missing corner with a cursor placed in space where the corner used to be.
- **Point-to-Line** measurement of missing corner or indication along an edge where a lack of 3D data or data artifacts prevent proper cursor placement.
- **Length** or **Point-to-Line** measurements of small features on flat surfaces when 3D data noise is significant relative to the feature size. This often occurs when the tip cannot be moved close enough to the indication to achieve better data quality.
- **Depth** measurement of turbine blade tip-to-shroud clearance where 3D data along the edge of the blade is missing or exhibits artifacts. This is often due to large MTD. Measurement may be accomplished by placing the **Measurement Plane** cursors on the face of the blade, the first three **Depth** cursors on the shroud, and the fourth **Depth** cursor on the edge of the blade near the **Measurement Plane**.
- Because the fourth **Depth** cursor is projected onto the **Measurement Plane**, DO NOT select a **Depth** measurement type with a **Measurement Plane** to measure pits or dents.

**Note:** *Once a user-defined Measurement Plane is added to an image, all measurements added before or after the plane was inserted utilize the Measurement Plane*



## Placing a Measurement Plane (3D Phase and 3D Stereo)

A measurement plane extends an object beyond its existing edges (like the surface of a broken compressor blade). This allows placement of measurement cursors within an area that does not include measurable image pixels.

**1** – Capture an image for measurement using either the 3DPM or 3D Stereo procedures. Alternatively, recall a previously stored 3D measurement image.

**2** – Select to begin the measurement process and insert a **Measurement Plane**. This icon appears in the status bar while the **Measurement Plane** is active.

**3** – Defining the **Measurement Plane** requires placement of three cursors on valid (not red) pixels. Notice that only **Measurement Plane** cursors are triangular.

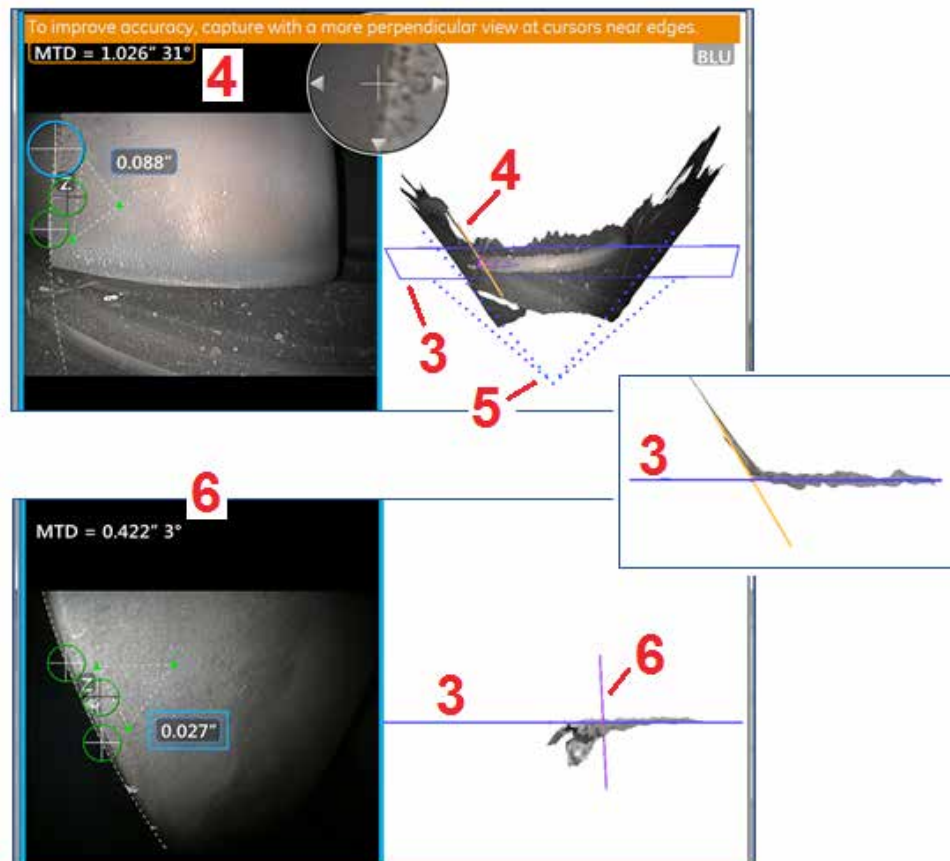
**4** – Once the third cursor appears, a semi-transparent **Surface Mask** is displayed. Points on the surface that are very close to being on the defined **Measurement Plane** (those whose distance from the plane is within 1% of their distance from the tip) are shown in green. Points lacking 3D data appear red. For best accuracy, adjust the cursor positions as needed to maximize the amount of green near the desired measurement location.

**5** – Rotate the **Point Cloud View** at any time to confirm that the **Measurement Plane**, indicated by a blue rectangle, aligns with the intended surface.

**6** – Select to add a measurement to the image, then choose the measurement type. While in this example shows an **Area** measurement, the **Measurement Plane** is compatible with any measurement type.

**7** – When measuring **Area**, all cursors are projected onto the **Measurement Plane**. Cursors may be placed anywhere in the image, even where no 3D data is present. [Click here to learn how each measurement type is affected by the Measurement Plane.](#)

**Note:** Once a user-defined **Measurement Plane** is added to an image, all measurements added before or after the plane was inserted utilize the **Measurement Plane**.



## Measurement Plane Warnings (Edge View Angle)

When using a **Measurement Plane** with **Point to Line**, **Area**, or **Depth** to measure near an edge, the viewing perspective can affect accuracy, especially if the edge has a significant radius.

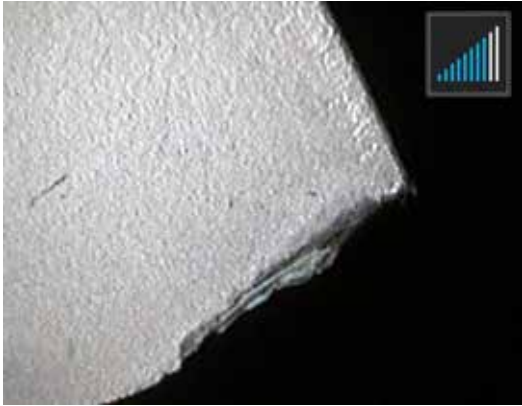
To help the user maximize accuracy, the system displays an **Edge View Angle (EVA)** value (1) next to the MTD and an **Edge View Angle Line (EVA Line)** (2) in the point cloud views. The ideal EVA of 0° occurs when the EVA Line is perpendicular to the **Measurement Plane** (3).

***Note:** Measurement error generally increases as the EVA increases when measuring near an edge. If the EVA exceeds an upper limit (25° for Point to Line, 35° for Area and Depth measurement types) with cursors placed near an edge, the system displays a warning message, flashes an orange outline around the MTD and EVA, and shows the EVA Line in orange (4).*

To reduce the EVA, inspect the Full Image point cloud, which represents the field of view with four dotted lines (5), and visualize how the relative positions of the tip and the object must be adjusted to make the EVA Line more perpendicular (6) to the **Measurement Plane**, which appears as a solid blue rectangle (or a blue line when viewed from the side) (7). Capture a new image with the adjusted positions, and repeat the measurement.



## 3D Phase Measurements (3DPM)



3D Phase Measurement optical tips include an LED based structured light projection system that allows the Visual iQ to produce a three-dimensional surface scan of the object. Measurements are then made directly on the surface and displayed on the image. Preliminary steps of matching cursors or marking shadow lines are not necessary.

### Maximum Target Distance - MTD Number

The 3D Phase Measurement system will display a number on-screen after a measurement is complete. While taking the measurement, an **MTD** number will appear (see the upper left corner of the figure below). **MTD** stands for Maximum Target Distance and is the distance from the 3D Phase Measurement tip to the cursor that is furthest from the tip. Small measurements, especially depth or depth profile (~0.020" or smaller) types, require low **MTDs** (< 0.5") for good accuracy. Large length measurements can be accurately made with larger **MTDs**. The viewing perspective and surface finish both significantly influence the level of noise in the 3D data and therefore the accuracy. The Point Cloud feature should be used to verify that the level of noise present is small relative to the size of the defect being measured. Unlike stereo measurements, 3D Phase Measurements do not use Accuracy Index.

### Taking 3D Phase Measurements

As with other measurement types, Phase Measurement accuracy improves as tip-to-target distance is reduced. The **3DPM Range Guide** icon can be used to gauge the suitability of the current tip-to-target distance for a given measurement. When the surface is too far for measurement, a single bar is shown, and measurement should not be attempted. As the tip is moved closer to the surface, more bars are illuminated. Large length measurements may be performed with few bars illuminated, while still achieving good accuracy. In general, the best accuracy is achieved by getting as close to the surface as possible.

Accuracy is generally best when viewing a surface from approximately a 45° angle, especially on surfaces that are shiny or have a speckled appearance.

When measuring surfaces with steps or long, deep features, a side view tip will give better results if the feature or step is horizontal. A front view tip will give better results if the feature or step is vertical (see image to the right). This is due to the LED orientations in the tips.

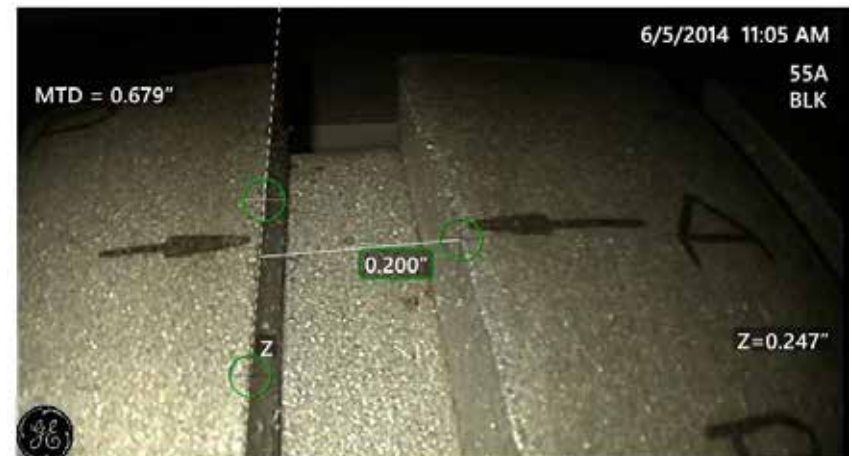
When an application calls for placement of measurement cursors within an area that does not include measurable image pixels, inserting a measurement plane extends an object beyond its existing edges (like the surface of a broken compressor blade or the space between a blade tip and a stationary rub strip).

#### To Capture a 3D Phase Measurement Image:

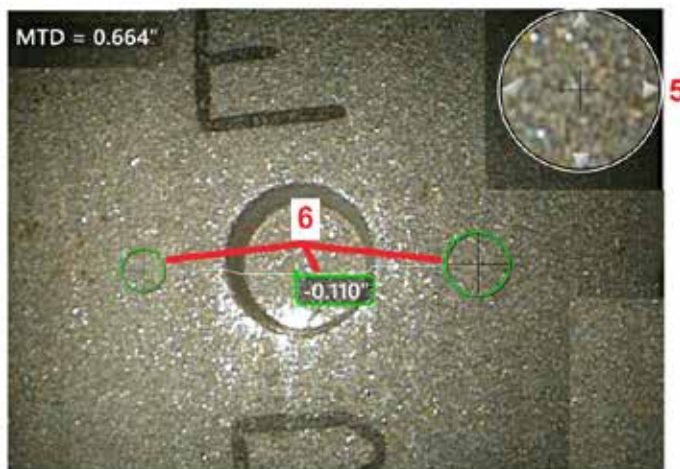
**Step 1** – Attach either a forward view or side view 3D Phase Measurement optical tip to the probe. Each measurement tip must be factory calibrated to a particular probe, and may be calibrated to more than one probe. To ensure measurement accuracy, verify the tip's accuracy each time it is installed. Refer to [Appendix E](#) for verification procedures.

**Step 2** – Verify that the Visual iQ system has automatically identified the 3DPM optical tip. The **3DPM Range Guide** appears near the upper right corner of the live image.

**Step 3** – Initiate the Image Capture sequence as described in the following section.








### 3D Phase Measurement Procedure



**1** – When the target is in position, select this soft key (or long hold ). The 3D Phase Measurement scan will begin.

**Note:** Hold the probe still for approximately one second during the surface scan. Multiple images are taken to complete the scan, and the probe must be held still during this sequence. Do not move the probe until the Capturing images... keep probe still caution disappears.

**2** – Select to begin the measurement process.

**3** – Select at any time to define a Measurement Plane. Once inserted into an image, all measurements added before or after the plane was inserted are made with respect to the Measurement Plane.

**Note:** When an application calls for placement of measurement cursors within an area that does not include measurable image pixels, inserting a measurement plane may allow the measurement to be performed. [Click here to learn more about Placing a Measurement Plane.](#)

**4** – Choose the type of phase measurement.

**5** – The **Patented Zoom Window** automatically opens allowing for precise positioning of the active cursor. Tap the window's edges (or tap on the cursor, then control with the joystick) to adjust the active cursor position. [Click here to learn about turning the Zoom Window on or off.](#)

**6** – Place cursors on the desired feature. Up to five measurements may be placed on each image.

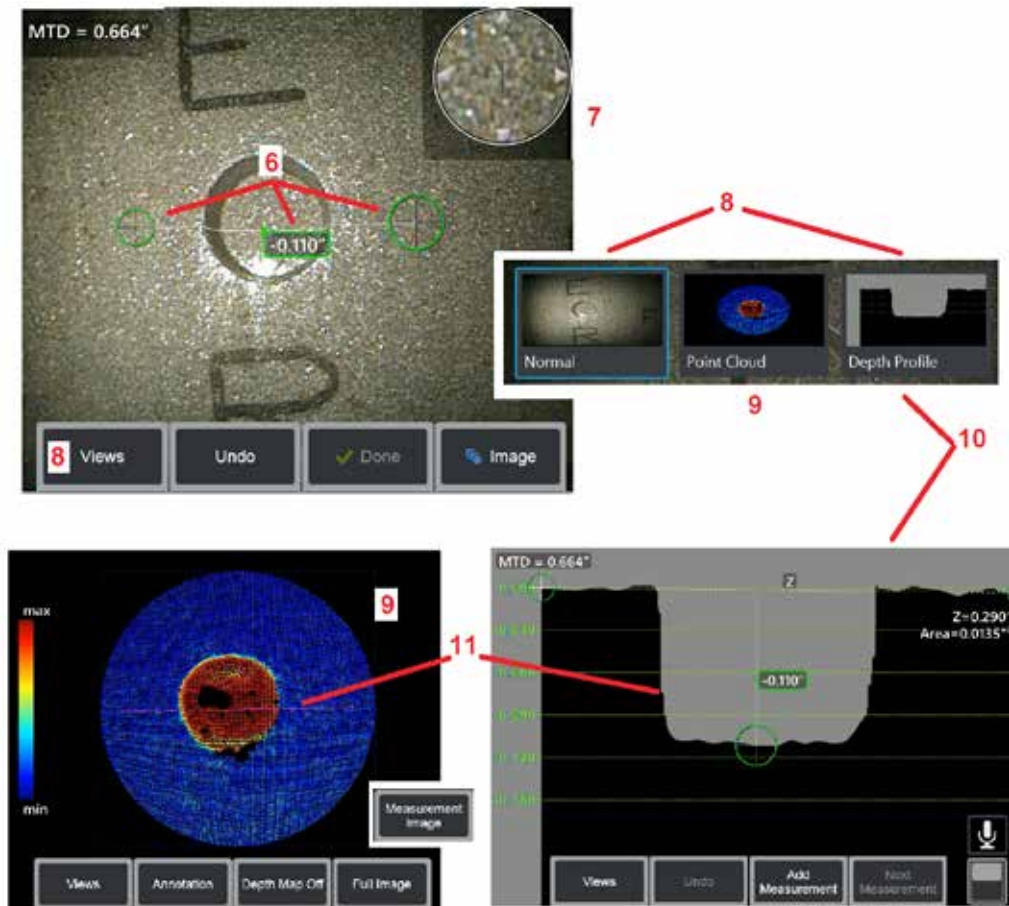
**Note:** The system will wait up to 1.5 seconds for movement to stop before starting a 3DPM capture. If movement does not stop, a message displays and the capture is not attempted. If movement begins during the capture, the system pauses the capturing process, waits for movement to stop, and attempts a second capture. If either attempt allows enough frames to be captured without movement to provide sufficient surface coverage, measurement is allowed. If neither attempt is completed without movement, a message indicating that the capture was affected by motion is displayed. This may result in more un-measurable (red) pixels or a slightly higher noise level than would be achieved with no movement. The system does not allow measurement if the movement was sufficient to substantially degrade 3D data quality.

## Making 3DPM Measurements (Depth Profile Example)

*Note: While the following procedure applies specifically to a Depth Profile measurement, refer to this procedure and the information in the section titled [Types of 3D Measurement](#) to conduct any type of 3DPM.*

**6** – To create a **Depth Profile** measurement, place the first and second cursors on a flat surface on opposite sides of the area of interest. This procedure is described in a following section.

*Note—Indication of Non-Measurable Area: When working with a 3D phase measurement image, certain parts of the image may not be measurable. These parts may be too far away, too dark, or obscured by light reflections if the surface is highly reflective. The 3D Phase Measurement system will display a red colored zone in those areas. The system will not compute a measurement result when a cursor is positioned in a red colored area. The 3D Phase Measurement system will display a yellow colored zone in areas where accuracy is likely reduced. Cursor placement in a yellow colored area should be avoided if possible.*



**7** – **Patented Zoom Window** allows for precision positioning of the active cursor. Tap the window's edges (or tap on the cursor, then control with the joystick) to adjust the active cursor position. [Click here to learn about turning the Zoom window on or off.](#)

**8** – Use to select from available **Views**. [Click here to learn about available Views.](#)

*Note: Depth Profile view (described in a following section) is only available if the 3DPM image includes a Depth Profile measurement.*

*Note: Measurements can be performed with any of the Image Views selected.*

**9** – **Point Cloud** view, described below, allows the user to evaluate the level of noise relative to indication size while verifying proper cursor and profile position for the desired measurement. Choose between **Measurement** and **Full Image** to view only the area around the active measurement or the entire image. When a **Point Cloud** is displayed, turning on the **Depth Map** uses color to convey the approximate depth of an indication (see left-hand scale).

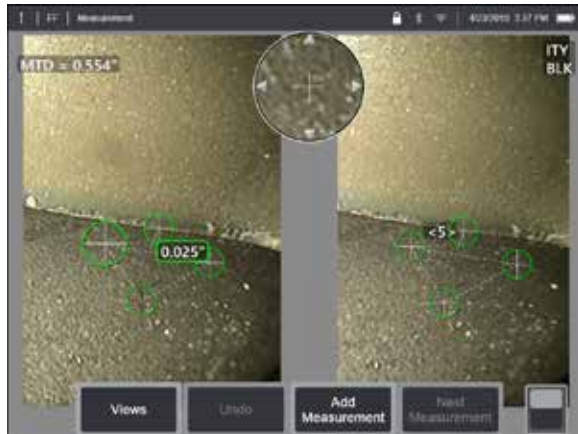
*Note: When Full Image is selected, all measurements appear in the Point Cloud view and the Depth Map colors represent distances relative to the Tip-to-Target Distance. When Measurement Image is selected, only the active measurement appears and the Depth Map colors represent distances relative to the user-defined depth-measurement reference plane.*

**10** – The **Depth Profile** view is available only after a **Depth Profile** measurement has been made.

**11** – The **Depth Profile** view provides a cross-section with the line connecting the two reference cursors serving as a sectioning line.



# 3D Stereo Measurements



Stereo measurements require the use of StereoProbe measurement tips to capture stereoscopic images of a target. 3D Stereo and Stereo both utilize the same Stereo optical tips, which provide two images of the same scene from slightly different perspectives. They both rely on triangulation and the matching of surface points in both images to determine 3D coordinates used for measurement. But, the use model and processing are very different. With Stereo, the system performs matching and computes 3D coordinates only at the locations of measurement cursors. With 3D Stereo, more advanced calibration and processing algorithms are utilized to compute a full 3D point cloud prior to beginning the measurement making its use more like 3DPM than stereo. The advanced processing also includes more intelligent matching and data smoothing to greatly reduce measurement variation. As with 3DPM, the Visual IQ allows 3D visualization of the 3D Stereo point cloud (hence the name 3D Stereo) to improve understanding of the viewed surface and the measurement being performed.

## Maximum Target Distance - MTD Number

As with other measurement types, 3D Stereo accuracy improves as tip-to-target distance is reduced. In general, the best accuracy is achieved by getting as close to the surface as possible while keeping the area of interest in sharp focus. Like 3DPM, 3D Stereo provides an MTD number for each measurement to help gauge the likely accuracy of that measurement (see the upper left corner of the figure below). MTD stands for Maximum Target Distance and is the distance from the stereo tip to the cursor that is furthest from the tip. Small measurements, especially depth or depth profile (~0.020" or smaller) types, require

low MTDs (< 0.5") for good accuracy. Large length measurements can be accurately made with larger MTDs. The Point Cloud feature should be used to verify that the level of noise present is small relative to the size of the defect being measured. Unlike Stereo, 3D Stereo does not use Accuracy Index.

When an application calls for placement of measurement cursors within an area that does not include measurable image pixels, inserting a measurement plane extends an object beyond its existing edges (like the surface of a broken compressor blade or the space between a blade tip and a stationary rub strip).

## The 3D Stereo Measurement Process

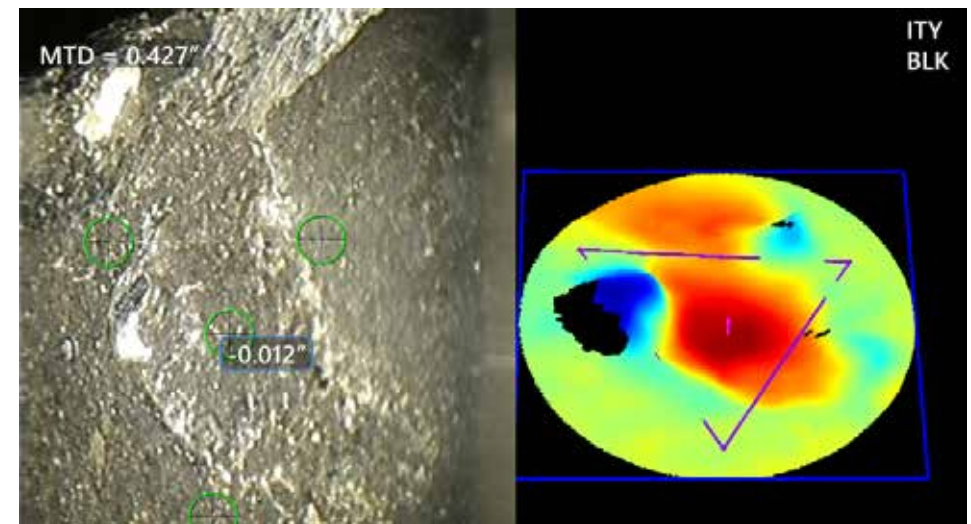
You can take 3D Stereo measurements on a frozen image or on a recalled image, provided the recalled image was saved with 3D Stereo measurement data. The 3D Stereo Measurement process includes:

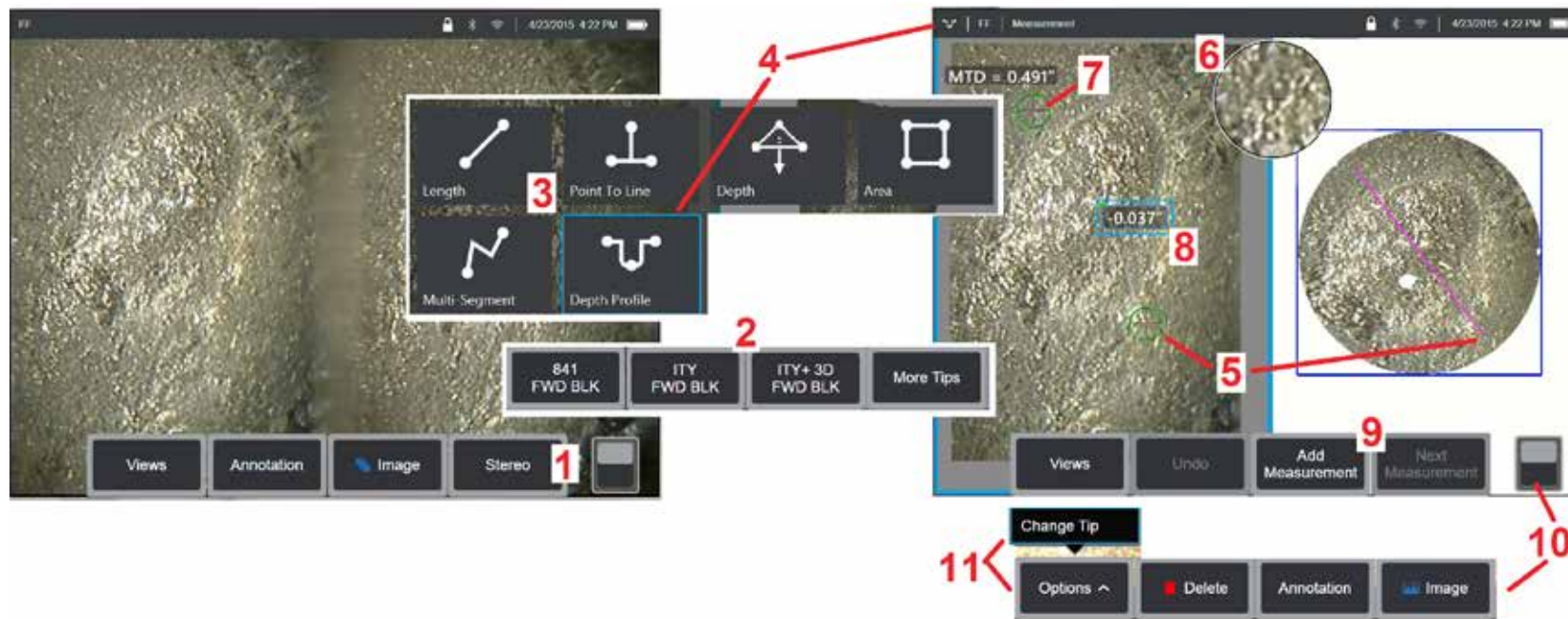
**Step 1**—Attaching a calibrated 3D Stereo Tip. Each measurement tip must be factory calibrated to a particular probe and may be calibrated to more than one probe. To ensure measurement accuracy, verify the tip's accuracy each time it is installed. Refer to [Appendix E](#) for verification procedures.

**Step 2**—Capturing an acceptable image. ([Click here to learn more about Images Suitable for Stereo Measurement](#))

**Step 3**—Identifying the attached optical tip, selecting desired measurement type and placing measurement cursors.

**Step 4**—Use the Point Cloud view to confirm an acceptable level of noise for the image being measured.





### 3D Stereo Measurement Procedure, Part 1

Prior to collecting 3D Stereo measurements, a calibrated 3D Stereo optical tip must be attached to your Visual IQ. Properly position the tip for measurement ([click here to see how to position the tip](#)), which may be aided by temporarily displaying a single image by turning **Single View** mode **ON** ([click here to select Single View](#)). The image capture and cursor placement process is described elsewhere – become familiar with this information before making stereo measurements.

**1** – Select the **Stereo** soft key (if working with a frozen image) or the **Measure** soft key (if working with a recalled image captured with a 3D Stereo optical tip). **Live stereo (and all other) images must be frozen prior to beginning the measurement process.**

**2** – After selecting **Stereo**, soft keys on the iQ's display show the serial numbers for all 3D Stereo and stereo tips that have been calibrated to the installed probe. 3D Stereo tips include a + **3D** designation on the soft key. Be sure to select the serial number of the 3D Stereo tip currently installed. If, after collecting images for measurement, you determine that the wrong serial number was selected, refer to items 10 and 11.

**Note:** When an application calls for placement of measurement cursors within an area that does not include measurable image pixels, inserting a measurement plane extends an object beyond its existing edges. [Click here to learn more about Placing a Measurement Plane.](#)

**3** – Begin the measurement process by choosing the type of measurement desired ([Click here for a description of each type of 3D Measurement](#))

**4** – When a measurement type is selected (in this case, a **Depth Profile** measurement), this icon describes the type chosen.


**5** – First cursor appears on the left screen, where all user-placement of cursors will occur. Drag with your finger (or joystick) to position the active cursor to the desired location. This cursor can be reactivated (active cursor appears larger than other cursors) and moved at any time.

**Note—Indication of Non-Measurable Area:** When working with a 3D Stereo measurement image, certain parts of the image may not be measurable. If portions of the image are unsuitable for stereo measurement, the measurement system will display a red colored zone in those areas. The system will not compute a measurement result when a cursor is positioned in a red colored area.

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## 3D Stereo Measurement Procedure, Part 2

**6 – Patented Zoom Window** allows for precise positioning of the active cursor. Tap the window's edges (or move the cursor with the joystick) to adjust the active cursor position. [\(Click here to learn about turning the Zoom Window on or off and other Measurement Settings\).](#)

**7** – Tap the screen (or hit ) to display the second cursor. Position it as described in items 5 and 6.

**8** – The active dimension appears on the display screen (tapping the number turns its box blue and allows it to be repositioned).

**Note: Verify correct cursor placement and 3D data quality using the Point Cloud view.**

**9** – Select to **Add** another measurement (up to five are allowed on any display). Once more than one measurement are displayed, select **Next Measurement** to change which measurement is active (or simply tap on any existing measurement cursor to make it active).

**10** – Tap to access alternate rows of soft keys. Double tapping in this location hides or displays the soft keys and status bar.

**11** – Select **Options**, then **Change Tip** to retain the image captured and measurement(s) performed while correcting for an incorrectly specified tip serial number. This process allows the correct calibration data to be applied and eliminates the need to collect additional images simply because the user initially identified the wrong tip serial number.

## 3D Stereo Measurement Types

[Click here to learn more about each type of 3D measurement.](#)



## Making 3D Stereo Measurements (Depth Profile Example)

*Note: While the following applies to a Depth Profile measurement, refer to this procedure and the section titled [Types of 3D Measurement](#) for other types.*

**1** – To create a **Depth Profile** measurement, place the first and second cursors on flat surfaces on the same plane on opposite sides of the area of interest.

**2** – **Patented Zoom Window** allows for precision positioning of the active cursor. Tap the window's edges (or tap on the cursor, then control with the joystick) to adjust the active cursor position. [Click here to learn about turning the Zoom window on or off.](#)

**3** – Use to select from available **Views**. [Click here to learn about Views.](#)

*Note: Depth Profile view (described in a following section) is only available if the active measurement is a Depth Profile measurement.*

*Note: Measurements can be performed with any of the Image Views selected. However, the 3D coordinates used for measurement and shown in the point cloud views are always computed using the Normal image.*

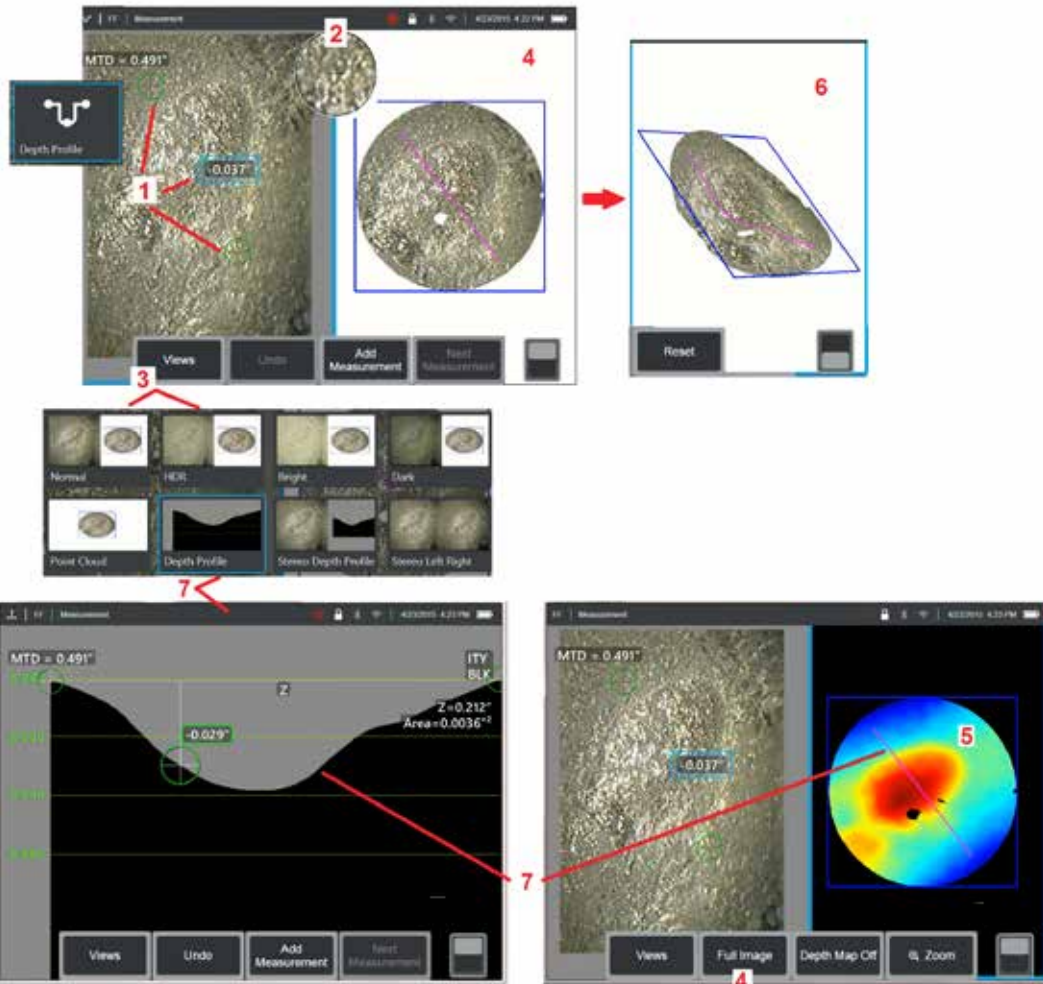
**4** – **Point Cloud** view, described below, allows the user to evaluate the level of noise relative to indication size while verifying proper cursor and profile position for the desired measurement. Choose between **Measurement Image** and **Full Image** to view only the area around the active measurement or the entire image.

**5** – When a **Point Cloud** is displayed and active, turning on the **Depth Map** uses color to convey the approximate depth of an indication.

*Note: When Full Image is selected, all measurements appear in the Point Cloud view and the Depth Map colors represent the Tip-to-Target Distance. When Measurement Image is selected, only the active measurement appears and the Depth Map colors represent distances relative to the measurement reference plane.*

**6** – When a **Point Cloud** view is displayed, drag a single finger over the touchscreen (or use the joystick) to rotate the image in three dimensions. Alternatively, place two fingers on the display and move simultaneously to reposition or rotate the image within the plane in which it is viewed. Select **Reset** to return the repositioned point cloud view to its original position.

**7** – The **Depth Profile** view is available only after a **Depth Profile** measurement has been made. This view provides a cross-section with the line connecting the two reference cursors serving as a sectioning line.





# Stereo Measurements

Stereo measurements require the use of StereoProbe measurement tips to capture stereoscopic images of a target — two pictures of the same target from two different angles. To measure the target, the Visual IQ uses triangulation based on these two side-by-side images. You can take stereo measurements on a frozen image or on a recalled image, provided the recalled image was saved with Stereo measurement data. The Stereo Measurement process includes *(see following sections for details):*

**Step 1** – Attaching a calibrated **Stereo Tip**

**Step 2** – Capturing an acceptable view with a suitable image as described below.

**Step 3** – Identifying the attached optical tip, selecting desired measurement type and placing measurement cursors.

**Step 4** – Properly positioning the **Matching Cursors**, if needed.

## Achieving a Suitable Image for Making Stereo Measurements

For maximum accuracy in any type of stereo measurement, you must begin by positioning the stereo tip carefully. To position the probe tip (before freezing) for a Stereo Measurement Image:

**Visibility**—The feature must be fully visible on both sides of the screen.

**Tip-to-target proximity**—The tip must be as close as possible to the target while keeping it in focus.

**Minimal glare**—Minimize glare by adjusting the viewing angle and the image brightness in the areas where you will be placing cursors. Small glare speckles do not present a problem, but larger glare areas may appear in different positions on the two sides, causing false matches.

**Vertical orientation**—If measuring distance between lines or across a circle, the image is oriented so that you can place cursors at left and right edges of the item to be measured — not at top, bottom or diagonal points. The system needs differentiated details to the left and right of each cursor to accurately place the matching cursors in horizontal relationship to the left-side cursors.



**Bad Example -- Object is:**  
Not fully visible on right side.  
Not well lit (optical tip needs to move closer to surface)  
Not oriented to allow placement of cursors at left and right edges of circle or gap



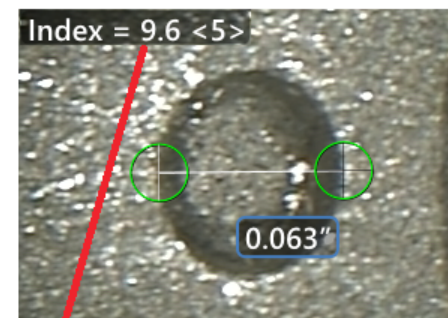
**Good Example -- Object is:**  
Fully visible on both sides.  
Well lit with minimal glare  
Oriented to allow placement of cursors at left and right edges of circle or gap

*The images above represent good and bad image capturing techniques when stereo measurements will be made. Both images were captured for length measurement across the slot.*

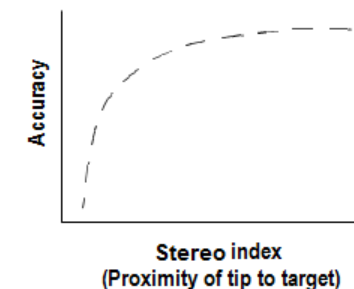
## About the Stereo Index

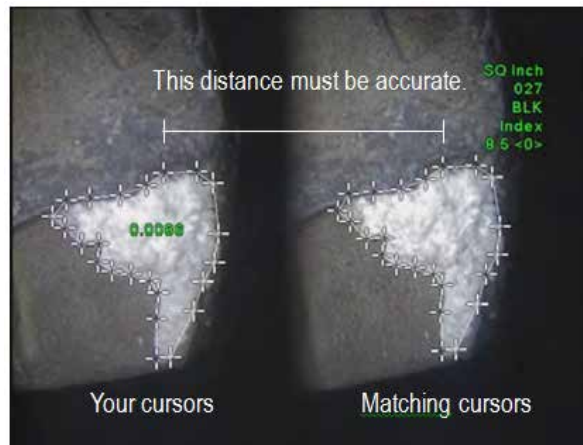
The stereo index is a number that indicates the amount of magnification **during stereo measurements**. The higher the stereo index, the greater the magnification, the more accurately you can place the measurement cursors and the more accurate your results.

When taking stereo measurements, you magnify the image not by zooming but by moving the optical tip as close as you can to the target. The stereo index can be turned ON or OFF and the minimum value (below which it flashes) can be altered. [Click here to learn about adjusting the Stereo Index Limit and other Measurement Settings.](#)



The stereo index can be displayed to indicate the amount of magnification you have achieved.





## About the Matching Cursors

For each cursor you place on the left image during stereo measurement, the system places a matching cursor on the right image for use in triangulation.

You must place each left cursor on an image point (a pixel) that has sufficient surrounding detail to differentiate it from its neighboring pixels. If the neighboring pixels look the same as the point you choose — especially the pixels to the point's left and right, for example, pixels along a smooth horizontal line — the system cannot accurately place the matching cursor. When there is enough differentiating detail, the “match strength” is high (**meaning that the generated match point clearly matches better than its neighboring pixels — the system's confidence in the match is high**). But if there is not enough detail, the match strength is low (meaning that the generated point and its neighboring pixels match almost equally well — the match may be correct, but the system's confidence in the match is low).

For every matching cursor, the system calculates a match strength value between <0> (lowest confidence) and <5> (highest confidence). If too little detail is present, the system simply does not generate a matching cursor. Whenever possible, try to achieve a match strength of at least <3>. If you cannot achieve this level, try capturing another image with less glare or more image details. (Adjust the tip orientation or image brightness.)

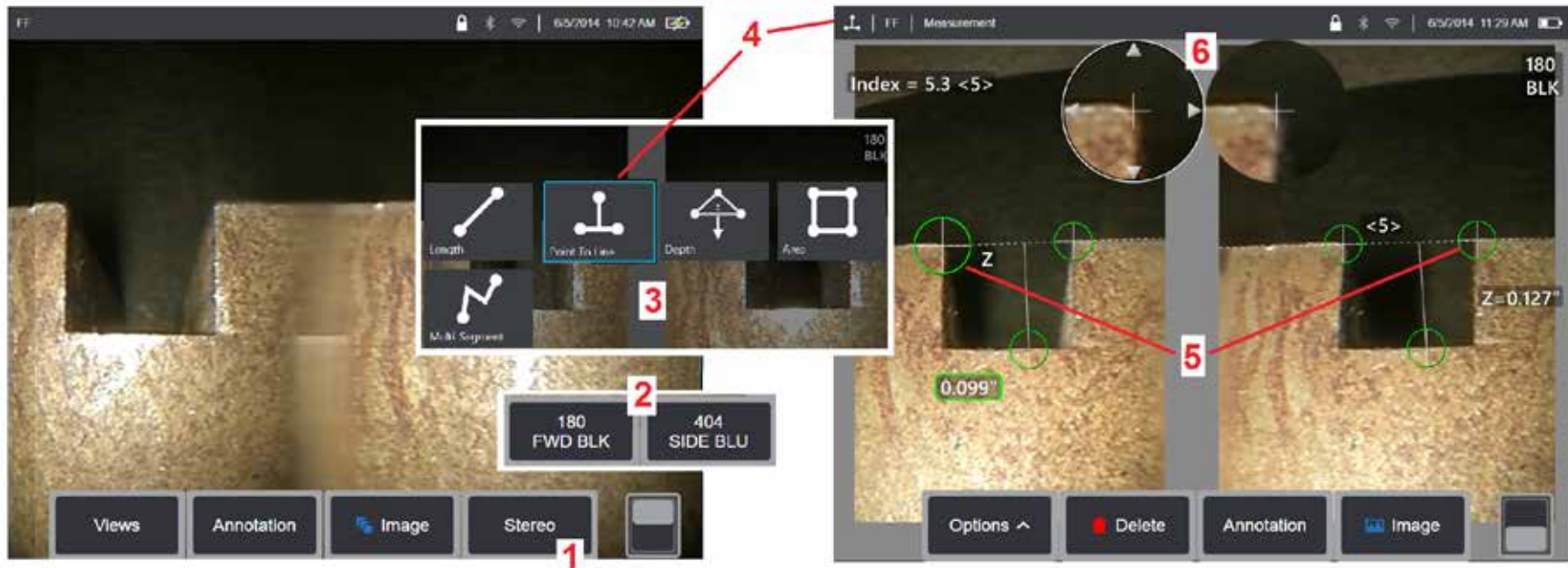
Even when match strength is <5>, and especially when the match strength is lower, you need to verify that the matching cursor appears to be placed properly. A matching cursor that is off by just one pixel can significantly impact measurement accuracy.

## Repositioning a Matching Cursor

**Note:** *Misplaced matching cursors most likely occur when the measurement area contains a repeating pattern. Generally, the best results are achieved by leaving the matching cursors exactly where the system places them.*

Move the matching cursor to the correct position.

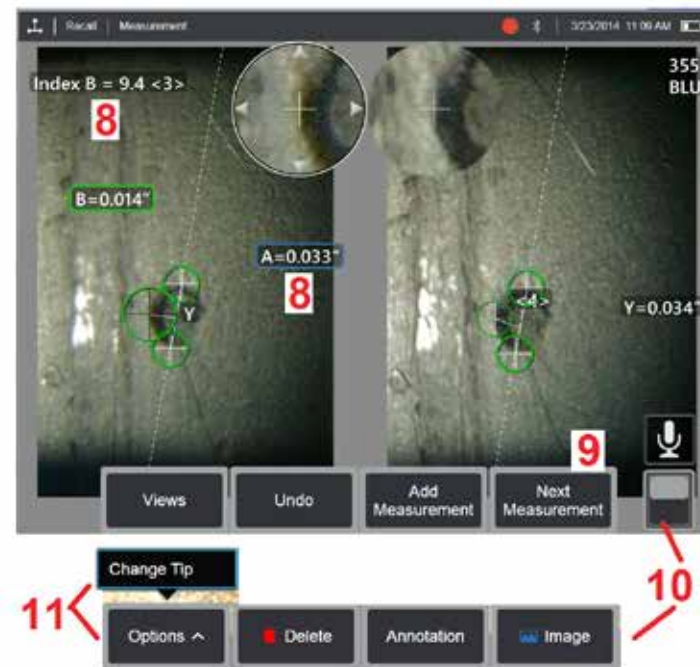
When you stop moving the cursor, the system optimizes the match position. Each manually corrected matching cursor is indicated by the absence of a match strength number.



## Stereo Mode Measurement Procedure, Part 1

Prior to collecting stereo measurements, a calibrated stereo optical tip must be attached to your Visual iQ. Properly position the tip for measurement ([click here to see how to position the tip](#)), which may be aided by temporarily displaying a single image by turning **Single View** mode **ON** ([click here to select Single View and learn about other Image Transformation settings](#)). The image and cursor placement process is described in the sections above – you must become familiar with this information before conducting stereo measurements.

- 1** – Select the **Stereo** soft key (if working with a frozen image) or the **Measure** soft key (if working with a recalled image captured with a stereo optical tip). **Live stereo (and all other) images must be frozen prior to beginning the measurement process.** Be sure to select the soft key showing the serial number of the attached tip.
- 2** – After selecting **Stereo**, soft keys on the iQ's display show the serial numbers for all stereo tips that have been calibrated to the installed probe. Be sure to select the serial number of the tip currently installed. If, after collecting images for measurement, you determine that the wrong serial number was selected, refer to items 10 and 11 on the next page of this manual.
- 3** – Begin the measurement process by choosing the type of measurement desired (*see description of each type below*)
- 4** – When a measurement type is selected (in this case, a **Point-to-Line** measurement), this icon describes the type chosen.
- 5** – First cursor appears on the left screen, where all user-placement of cursors will occur (the matching cursors appearing in the right display are generated by the Visual iQ system – as the user moves each left-screen cursor, the matching cursor in the right half-screen moves accordingly – be sure to inspect each matching cursor as it appears). Drag with your finger (or joystick) to position the active cursor to the desired location. This cursor can be reactivated (active cursor appears larger than other cursors) and moved at any time (*see additional screen features described below*).
- 6** – **Patented Zoom Window** allows for precise positioning of the active cursor. Tap the window's edges (or move the cursor with the joystick) to adjust the active cursor position. ([Click here to learn about turning the Zoom Window on or off and other Measurement Settings](#)).



## Stereo Mode Measurement Procedure, Part 2



**7** – Tap the screen (or hit ) to display the second cursor. Position it as described in items 5 and 6.

**Note:** Generally, you get the best results by leaving the matching cursors exactly where the system places them. However, under certain circumstances, such as when a repeating pattern exists, you may need to help the system find the correct match.

**8** – The active dimension appears on the display screen (tapping the number turns its box blue and allows it to be repositioned) along with the **Stereo Index** and **Match Strength** associated with this measurement and cursor placement. See the immediately preceding manual sections for a description of these two concepts.

**9** – Select to **Add** another measurement (up to five are allowed on any display). Once more than one measurement are displayed, select **Next Measurement** to change which measurement is active (or simply tap on any existing measurement cursor to make it active).

**10** – Tap to access alternate rows of soft keys. Double tapping in this location hides or displays the soft keys and status bar.

**11** – Select **Options**, then **Change Tip** to retain the image captured and measurement(s) performed while correcting for an incorrectly specified tip serial number. This process allows the correct calibration data to be applied and eliminates the need to collect additional images simply because the user initially identified the wrong tip serial number.

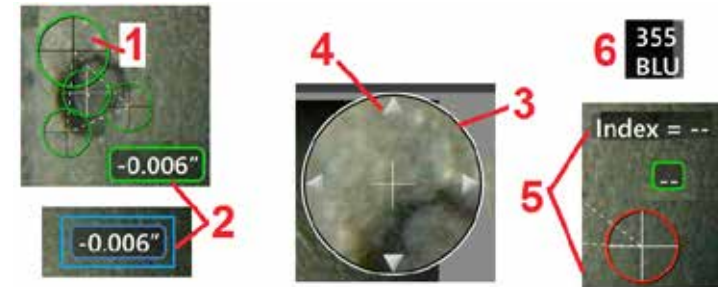
**Note:** The **Stereo Index** and **Match Strength** shown apply only to the active measurement.

**Note:** To verify your measurement accuracy, move each left-side cursor a few pixels. If the matching cursors move identically, and if the results change only a little, you have probably achieved accurate results. But if a matching cursor's movement is erratic, or if the results change significantly, your results are unreliable. capture a fresh image, following the guidelines above. This step is especially useful if you have to use a low Stereo Index (less than 5) or low confidence number (less than 3). For example, you might have to use a low Stereo Index if you are measuring a large object or if you have limited access and cannot bring the tip close to the target. You might have to accept a lower confidence number if the surface has few details.



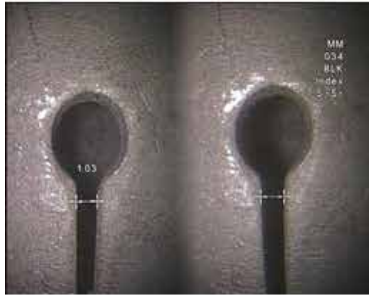
## Features of the Stereo Measurement Screen

- 1** – The currently active cursor appears larger than all others. Note that this cursor's position can be altered by the joystick or by dragging it across the screen.
- 2** – Tap any on-screen dimension to select it for repositioning (by dragging or with joystick)
- 3** – The highlighted Zoom Window allows for precise positioning of the active cursor. Select and drag it to change its location on the display screen.
- 4** – Tap on these arrowheads near the perimeter (or use the joystick) to move the cursor.
- 5** – Any cursor positioned where a lack of image detail prevents the system from finding a matching point changes color to red (and all dimension and index numbers revert to dashes).
- 6** – The type and serial number of optical tip currently selected ([click here to identify the stereo tip](#))



## Stereo Measurement Types

This section specifically addresses cursor placement for each type of stereo measurement.

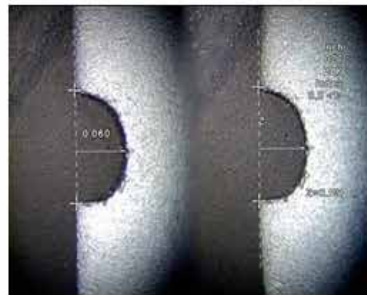


### Description:

Linear (Point-to-Point)

### Cursor Placement:

Place both cursors

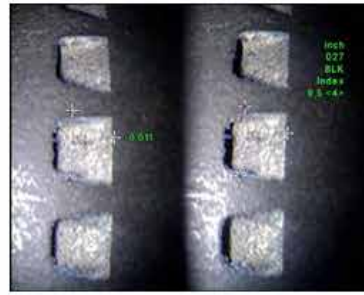


### Description:

The perpendicular distance from a point to a line

### Cursor Placement:

Place the first two cursors to define a reference line. Place the third cursor at the perpendicular distance you want to measure



### Description:

The perpendicular distance between a surface and a point above or below it.

Used to evaluate changes due to wear, misalignment, and other causes.

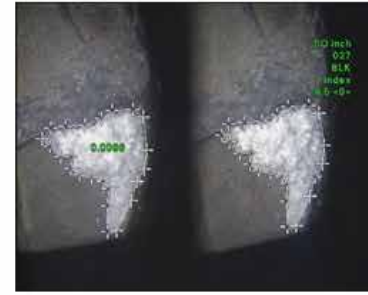
Negative measurements indicate that the point lies below the plane. Positive measurements indicate that it lies above

### Cursor Placement:

Place the first three cursors to define a reference plane. Place the fourth cursor at the perpendicular distance you want to measure.

Note: Depth measurements taken at a low accuracy index are particularly sensitive to the matching cursor's position. If the accuracy index is low, increase it by bringing the probe tip closer. If you cannot increase the accuracy index, place cursors so that they yield high match strengths, and verify your accuracy.

[\(Click here to learn more about the Stereo Mode Measurement Procedure\).](#)



### Description:

The surface area contained within multiple cursors placed around a feature or indication.

### Cursor Placement:

Place three or more cursors (up to 24) around the edge of the area you want to measure.

When finished, select **Done** or press



twice. The area closes.



### Description:

The length of a nonlinear feature or indication.

### Cursor Placement:

Place two or more measurement cursors (up to 24) to create segments along the feature.

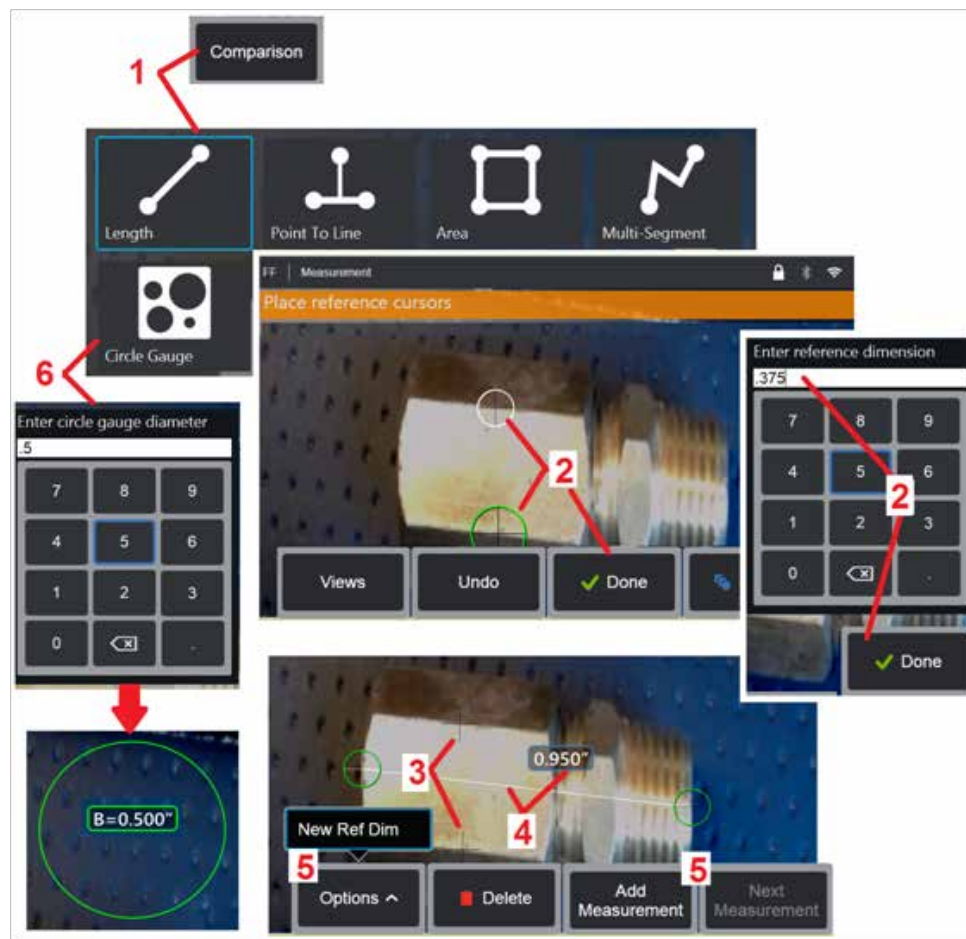
When finished, select **Done** or press



twice. The line is finalized.







## Comparison Measurements

Comparison measurements rely on the known dimensions of an object that has been set in the field of view either by the manufacturer or by the probe or takes advantage of known dimensions within the frozen image. The Visual IQ processor uses these known dimensions as a reference scale for measuring an unknown target. You can take comparison measurements on a frozen (non-3DPM) image or on a recalled image that was saved in **Comparison** measurement mode.

### Making a Comparison Measurement

Use the head guard or attach any standard forward-view or side-view tip to the probe. Select the **Field of View (FOV)** for your tip from the soft key or the touch screen. This allows the system to improve accuracy by compensating for the tip's optical distortion. If FOV is not known consult [Appendix B](#). Position the probe tip for maximum accuracy, by making the surface to be measured appear perpendicular to the probe view. The target and known object should both be in the same plane at the same distance from the probe with the tip as close as possible while fitting them both fully into the image. If the object and reference are small on the screen, zoom in. Freeze the display before beginning the measurement process.

- 1 – Select to launch the **Comparison** measurement mode. Begin by selecting the measurement type. [Click here to view a description of each measurement type.](#)
- 2 – A reference of known length must next be input by placing two cursors and defining the reference length.
- 3 – The reference length cursors remain.
- 4 – Arrange measurement cursors to determine the unknown dimension. In this case, the system is performing a **Length** measurement.
- 5 – Select to input a **New Reference Dimension**, **Add** another measurement (up to 5), or change the active measurement (by selecting **Next Measurement**).
- 6 – Once a reference length is defined, a circle of known diameter can be displayed on the image by selecting this option. The circle gauge may be used as a “go/no-go” gauge when its diameter is set to a defect size limit.

---

# Troubleshooting Measurements

## 3D Phase, 3D Stereo, or Stereo Measurements

- Move the probe tip as close as possible to the target, maximizing magnification.
- Verify that the optical tip is threaded on to the probe head securely.
- Measure the target contained in the verification block to ensure that no tip damage has occurred. [Click here to learn more about Verifying Measurement Tips.](#)

## 3D Phase Measurements

- Be sure to hold the probe still for approximately one second during the surface scan. Do not move the probe until after the **Capturing Images** message disappears.
- Reposition the probe tip until the range finder bar pattern on the Live screen shows the maximum possible number of blue bars. It is acceptable to be slightly out of focus for very small indications.
- Make sure all measurement-tip surfaces are clean. Wipe with a clean cloth and alcohol.
- After capturing an image, verify that the tip attached to the probe matches the tip that is selected in the software.
- Check point cloud view for excessive waviness or ripple, which would indicate dirt or oil contamination or tip damage.
- Try a non-perpendicular view, such as 30-45°. This often significantly decreases the noise level in the data, especially for surfaces that are shiny or have a speckled appearance.

## 3D Stereo and Stereo Measurements

- Avoid placing cursors in areas of significant glare. If necessary, adjust the brightness or reposition the probe tip to enhance details and reduce glare.
- Verify that the object to be measured is near the center of the screen.
- Activate the zoom window to most accurately place the measurement cursors.
- Review guidelines under [Achieving a Suitable Image for Making Stereo Measurements](#)
- Verify that the matching cursor is correct within 1 pixel (Stereo only). If you cannot clearly see where the match point should be, select a different point, or capture the image from a different angle that better reveals details to allow better matching.
- Verify that the serial number engraved on the tip matches the serial number selected in the software for measurement. **Note: The user-input tip serial number appears in the measurement screen's corner.**

# Managing Files

## Working with Removable Storage Devices

One or more USB storage devices can be connected to the iQ, accessed through its File Manager, written to and copied from, and Ejected using the features described here. The optional DVD drive may not serve as either the default or alternative saving location. Instead, files must first be saved in a directory located in the iQ's hard drive or on a connected USB storage device. Files can later be copied and pasted to the optical media in the attached DVD drive. **Note: Each time files are pasted to the DVD drive, the optical media is auto-ejected to avoid loss of data.**

**1** – Insert the USB Storage Device or DVD reader/recorder into either of these ports.


**Note: The Visual iQ is compatible with certain DVD reader/recorders and Write Once media (either DVD or Blue Ray format), such as a DVD+R. While files can be either added to or deleted from an attached DVD reader/recorder, deleting the file simply hides it from view. Deleting a file from Write Once media does not increase available space on the DVD or Blue Ray.**

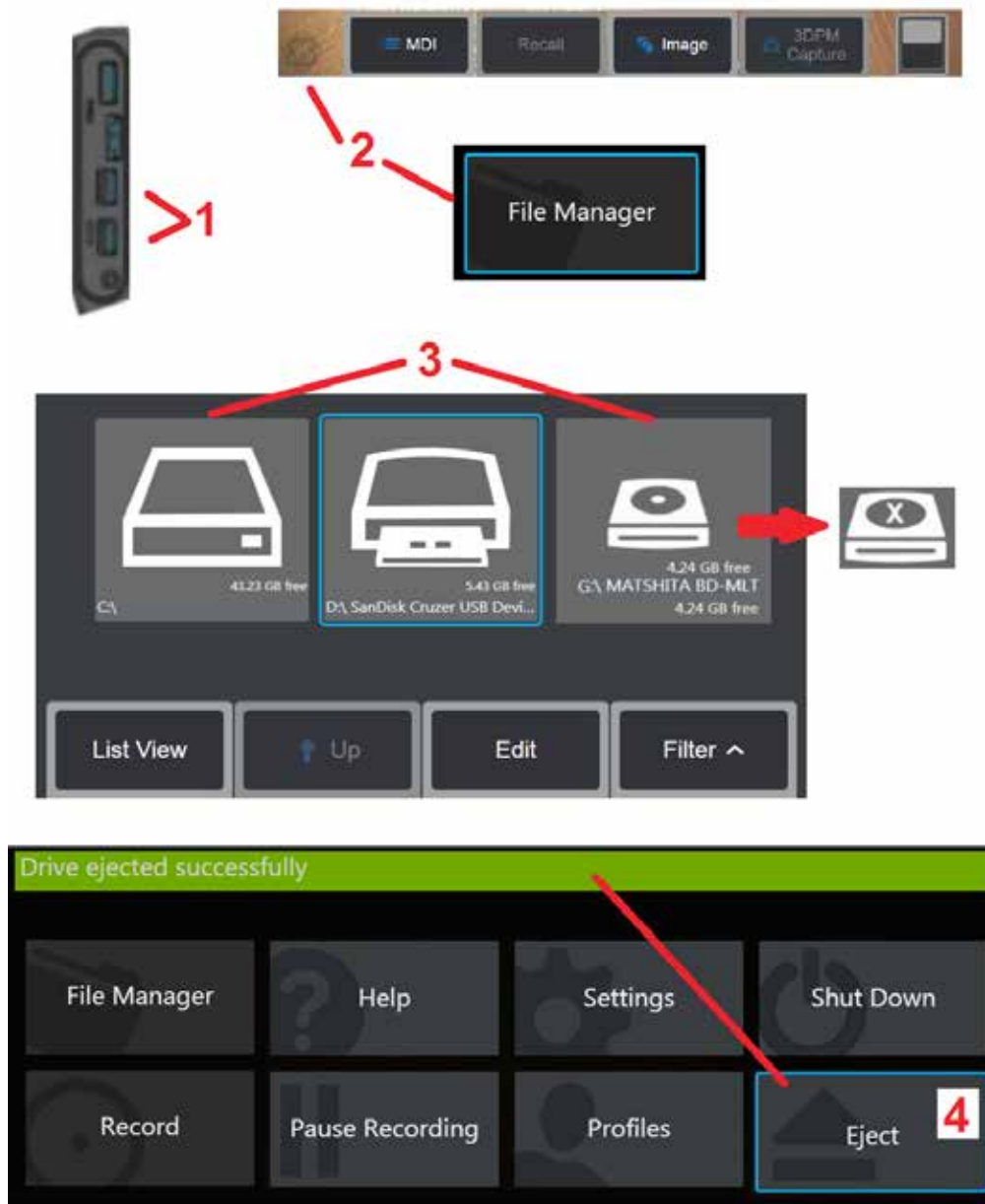
**2** –To access files or folders on the USB or DVD drive, tap the on-screen **GE Logo** (or press

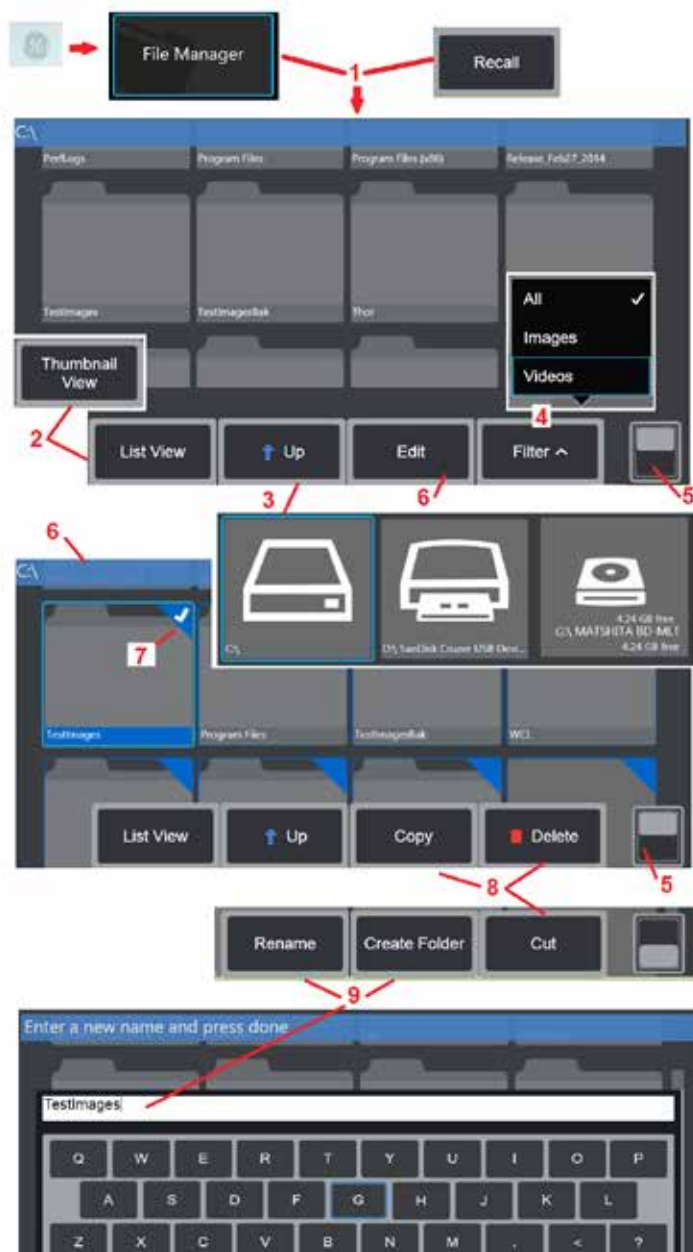
the  hard key) to open the **Global Menu**, then select **File Manager**.

**3** –Select the desired device, then navigate, access files or folders, and write to or copy from the drive as you would work with the iQ's internal memory. Each time files are pasted to the DVD drive, the optical media is auto-ejected to avoid loss of data. [Click here to learn more about working with the File Manager.](#)

**Note: When a DVD reader/recorder is attached to the Visual iQ, the File Manager icon representing it indicates whether it contains formatted media (as appears in the left view) or non-formatted media (see right view). Blank, unformatted media will be automatically formatted upon insertion into a DVD recorder/reader attached to an MViQ.**

**4** –**Before removing the USB or DVD drive,** tap the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then select **Eject**. **It will be safe to remove the drive once this message appears on the display.**






## Editing Files and Folders/Creating Folders

Image and video files can be stored in the Visual iQ or a detachable device. The **File Manager** feature allows these stored files (or the folders in which they are stored) to be **Copied, Cut, Pasted, Deleted, Renamed, or Created** (in the case of folders). Follow these steps to **Edit** files or folders:



**1** – To edit files or folders, tap the on-screen **GE Logo** (or press the  hard key) to open the **Global Menu**, then select **File Manager**. Alternatively, select the **Recall** soft key (when enabled), which allows you to recall a stored image or video and/or edit files and folders. To **Create a New Folder**, first access the **File Manager**, then navigate to the drive location where you want to create the new folder and proceed to Item 5 below for additional instructions.

**2** – Controls the **File Manager's** appearance (**Thumbnail View** shown here).

**3** – Select to navigate to the next higher directory within the **File Manager**.

**4** – Choose which file types to display.

**5** – Tap to switch between the **Soft Key Bar's** top and bottom row. To **Create a New Folder**, select **Create Folder** from the bottom row and proceed to Item 9 below for additional instructions. Double tapping in this location hides or displays the soft keys and status bar.

**6** – Select to turn on the file Editor function, which allows you to **Copy, Rename**, and otherwise **Edit** stored folders (or files).

**7** – Tap on a folder (or file) to select it for editing. The white check appears in the corner of all selected folders or files.

**Note: The Edit function must be activated and the file (or folder) selected – so that a white check appears in its corner – before editing.**

**8** – Once selected for editing, the folder or file can be **Copied** (or **Cut**) and **Pasted** or **Deleted**.

**Note: Each time files are pasted to the DVD drive, the optical media is auto-ejected to avoid loss of data.**

**9** – Once selected, a folder (or file) can be **Renamed**. When renaming (or creating a new folder), the virtual keyboard opens.

**10** – Select to choose from numeric characters or symbols.

**11** – Tap after typing the desired name.

# MDI

## Loading and Unloading Menu Directed Inspections

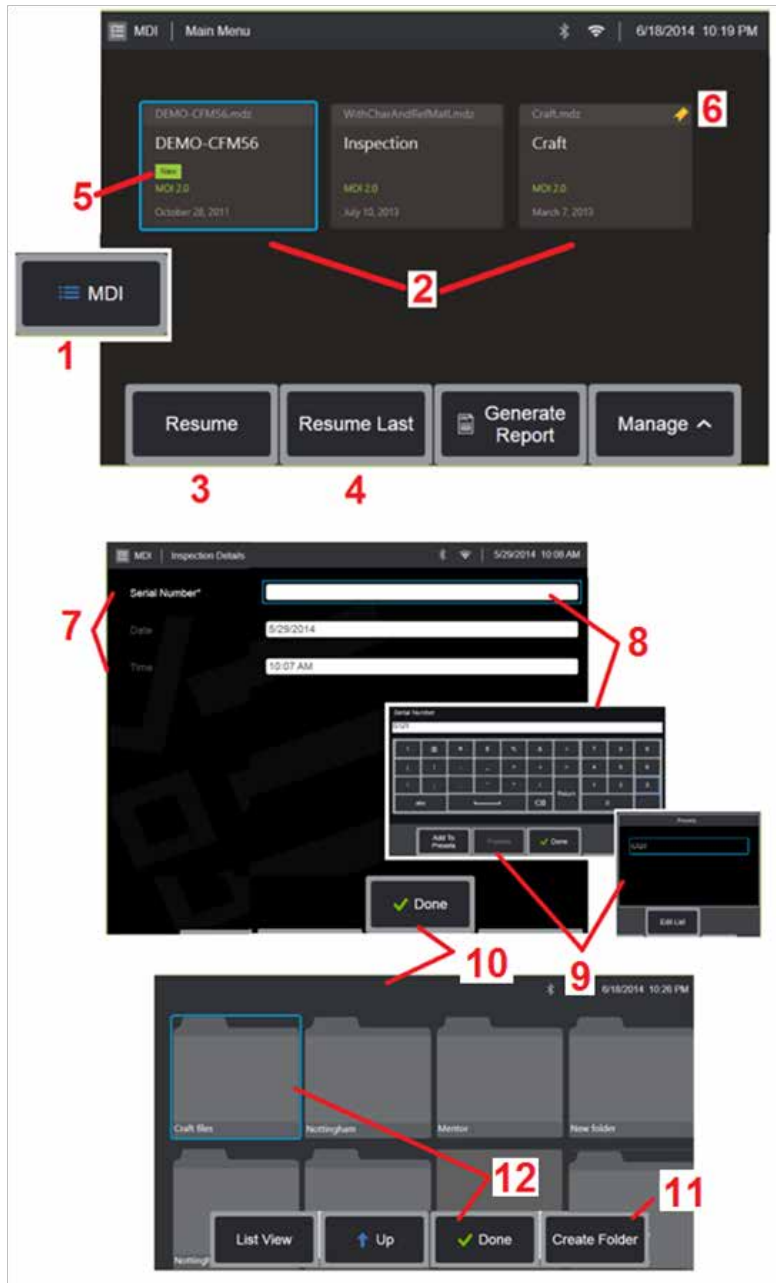
Follow this process to load or unload a Menu Directed Inspection.

**Note:** MDI inspection files have the file extension of .mdz. A maximum of fifty MDI inspection files may be loaded at any given time.

- 1 – Select to launch the MDI process.
- 2 – Select to browse for and **Resume** a previously active inspection.
- 3 – **Resume the Last** active inspection.
- 4 – **Load** a new inspection or **Delete** an existing one.
- 5 – Navigate the **File Manager** to select a file to **Load** or **Delete**.
- 6 – Select to **Complete** the loading process.
- 7 – Indicates a newly loaded inspection.
- 8 – Indicates the last active inspection.







## Starting a Menu Directed Inspection

- 1 – Select to begin the **MDI** process.
- 2 – Select any loaded inspection.
- 3 – Select to browse for and **Resume** a previously active inspection.
- 4 – **Resume the Last** active inspection.
- 5 – Indicates a newly loaded inspection.
- 6 – Indicates the last active inspection.

## Entering Study Level Information

At the start of an MDI inspection, you are prompted to enter the study level information and to select the directory (folder) into which your inspection results will be saved.

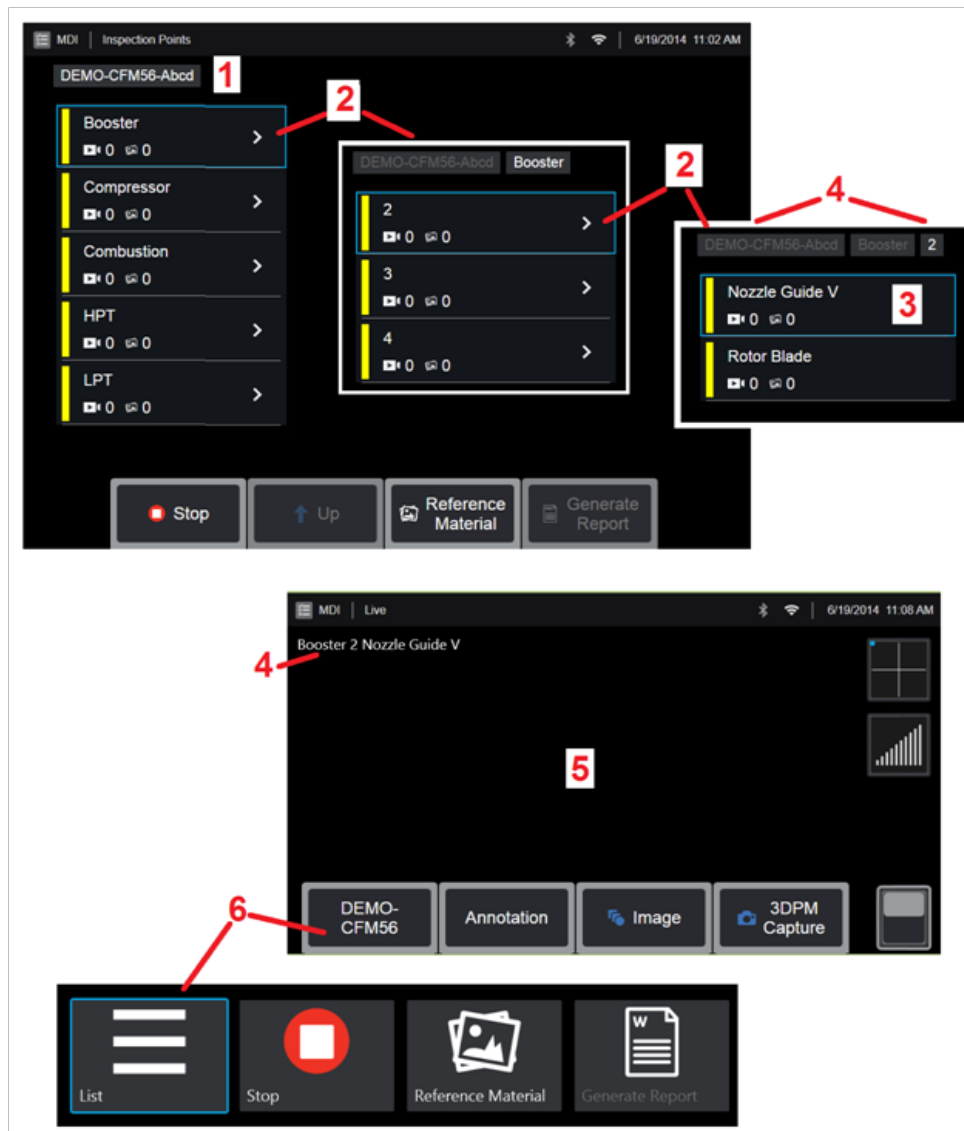
- 7 – **Study Level Information** (varies for each MDI) is entered at the start of an inspection. Information marked \* is required before collecting results.
- 8 – To enter information, simply choose the corresponding line and the **Virtual Keyboard** will automatically launch.
- 9 – Use the keyboard to enter information or choose from a user-generated set of **Preset** entries.
- 10 – Select when finished entering all **Study Level Information**.
- 11 – You must then identify the **Folder** (directory) into which results acquired during the MDI process are saved. Either **Create a New Folder** or choose an existing one.
- 12 – Select to complete the information input process.



## Selecting an Inspection Point

At this time, you can navigate through the inspection levels until you have reached the desired inspection point.

- 1 – Inspection name and equipment serial number.
- 2 – Select to navigate to the inspection's next-lowest organization level.
- 3 – Navigating to the **bottom** level of the inspection allows you to record images and videos.
- 4 – These labels indicate the level(s) within the inspection, identify your current position, and allow for navigation (using the touchscreen) between inspection points
- 5 – [Click here to learn more about capturing images](#) or [Click here to work with videos](#).
- 6 – Select soft key labeled with the **Inspection Name** to access this **MDI Leaf Menu**. Use this menu to navigate the List of inspection levels, Stop the current inspection, access **Reference Material** related to the inspection, or **Generate a Report** listing the results stored for the current inspection.



## Saving an Image or Video in an MDI Inspection

To save an image in the selected inspection point, press the SAVE hard key. During the save process, some of the following are available:

**Required Characterization** - If required, a characterization list appears before the save menu. You must select an entry to continue.

**Save** - Saves the image with the associated MDI data and filename.

**Save with Flag** - Saves the image with "FLAG" appended onto the filename. If you use this option, you can then generate a report including only the flagged images.

**Observation** - Assign characterization to this image.

**Add Comments** - Save typed comments along with the image. When generating a report, these comments are associated with the specific image.

**Add Audio Comments** - Record audio comments along with the image.

**Note:** The system automatically names the image to correspond to the location in the MDI file currently selected.

**1** - Press this hard key to save the frozen image into the selected inspection point. Double pressing this key saves a **screenshot** of the display screen.

**Note:** Screenshots are BMP image files of the display screen, do not contain RVI data of any type, are stored in an automatically created subfolder titled "Screenshots," and are assigned a file name beginning with the letters "ss."

**2** - Save Options are described above (not all appear in every MDI).

**Note:** Save (or Save With Flag) only after all Comments, Observations, or Audio Comments are entered as this added information will then be associated with the saved image.

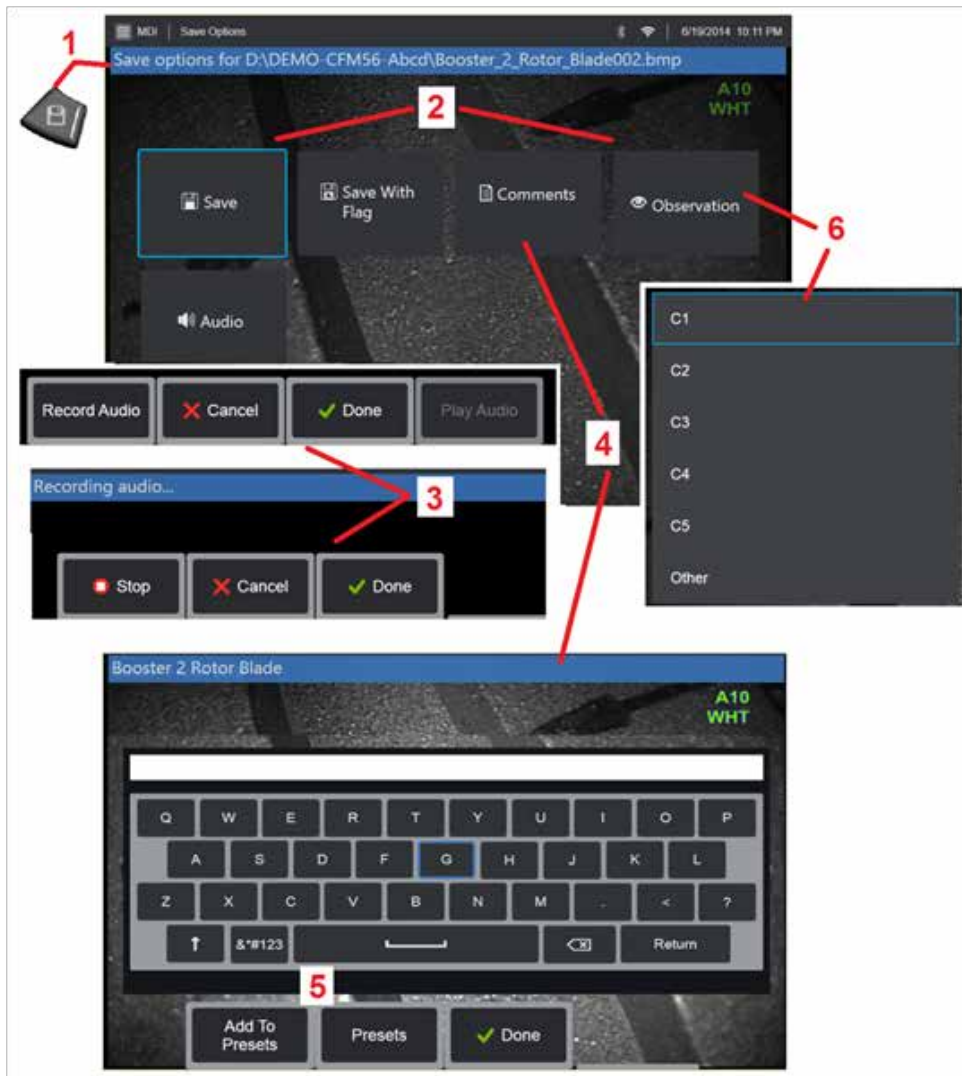
**3** - These menus allow the user to add **Audio Comments** to any image prior to saving. Be sure to select **Done** to complete the audio-comment recording process.

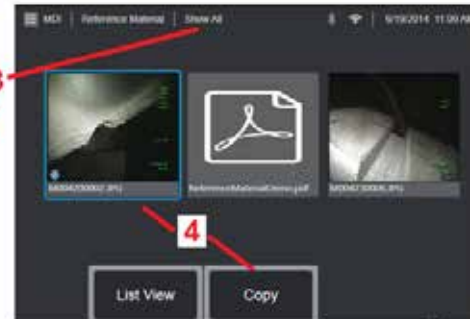
**4** - Select **Comments** to enter written comments to be saved with the image.

**5** - Entered comments can be added to a list of **Preset** comments from which you can later select.

**6** - Choose **Observations** from a pre-loaded list

**Note:** Images and Videos saved using MDI are located in the inspection folder created at the beginning of the inspection. The image or video file has Meta data associated with it to ensure communication with data management software such as GEIT Rhythm.



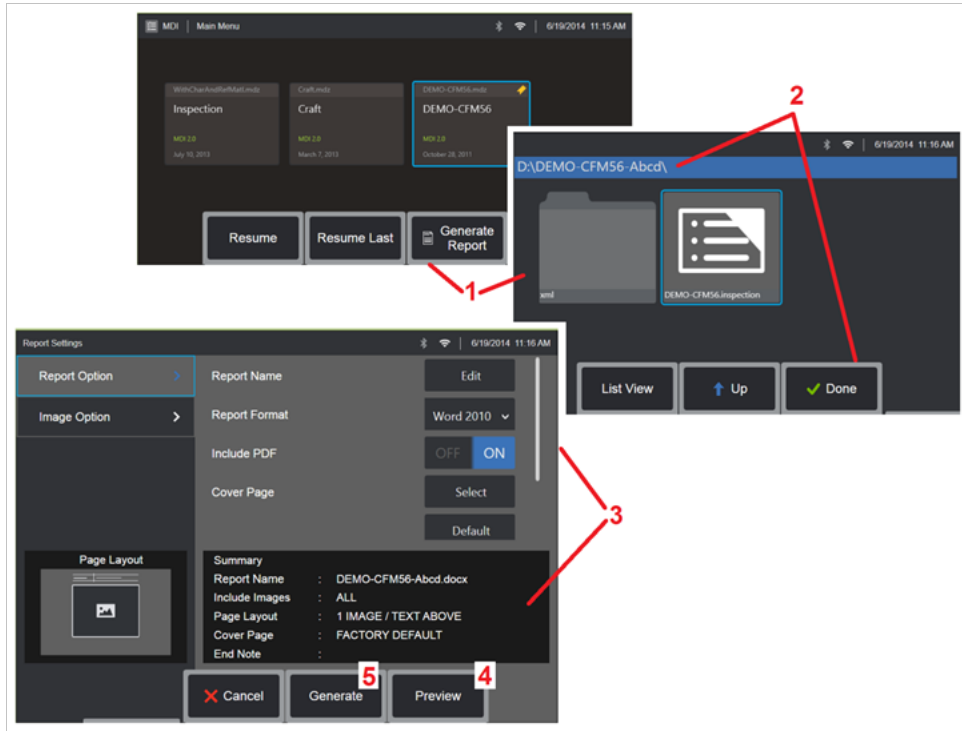


## Viewing Reference Material

- 1** – Select at any level within the inspection to access **Reference Material** associated with the level or point
- 2** – Select any PDF, image, or video material to open and view on the Visual iQ display
- 3** – Select **Show All** to access all **Reference Material** associated with the active inspection, which may be more than the material associated with the active level.
- 4** – Select to **Copy** and paste all reference material for the active inspection *into the folder identified at the beginning of the inspection for storage of results.*

## Stopping and Resuming an Inspection

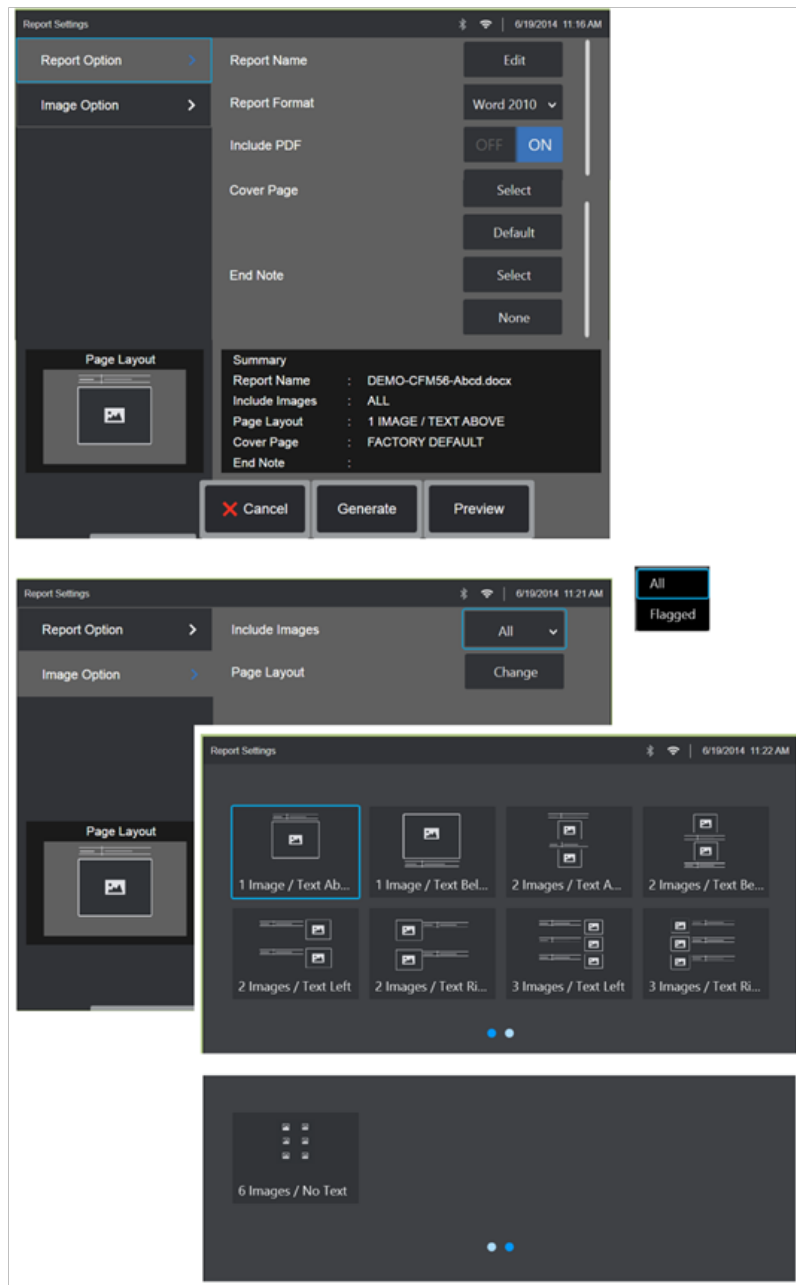
To stop an inspection, which may be resumed or finished at a later time, access the **MDI Leaf Menu** by selecting the soft key bearing the inspection's name and select **Stop**. To resume a previously stopped inspection, select the **MDI** soft key, then choose to either **Resume the Last** inspection or browse for a previous inspection to **Resume**.



## Generating an MDI Report

Follow this process to generate an MDI report.

- 1 – Select to **Generate a Report** and, if no inspection is active, choose the desired inspection.
- 2 – After selecting the inspection for which you wish to generate a report, choose **Done**.
- 3 – Report contents, page layout, and other features can be customized as described in the next section of this manual.
- 4 – **Preview** the report on the Visual iQ display.
- 5 – **Generate** an MS Word version of the report, which will be saved in the folder identified for this inspection.



## Customizing an MDI Report

Customize an inspection report by specifying the following parameters:

### REPORT OPTIONS:

- **Report Name** – Override the automatic inspection report file name.
- **Report Format** – Choose the version of MS Word in which to publish.
- **Include PDF** – Creates a PDF version of the report (can view on the Visual IQ display).
- **Cover Page** - Select the cover page to include in the inspection report.
  - FACTORY DEFAULT - Use the factory default settings for all parameters.
  - BROWSE - Select an MS Word doc to use as report cover page.
- **End Note** - Select the pages to include as the last pages of the report
  - NONE - Don't include any custom features in your inspection report.
  - BROWSE - Select an MS Word doc to include as report end note.

### IMAGE OPTIONS:

- **Include Images** - Select either all images or only flagged images to be included in the inspection report.
- **Image Layout** - Select from several styles of text and image layout or select No Text




# Maintenance and Troubleshooting

## Inspecting and Cleaning the System

Inspect and clean the Visual iQ system before and after each use. If using the system in a dirty environment, clean the components more frequently as needed.


If images are distorted or blurred within normal range, and if the optical tip is securely threaded, the most likely problem is dirty optical surfaces. For best image quality, clean the optical tip and camera head frequently.


If you discover conditions that require evaluation or repair, return the system to GE Inspection Technologies. Early repair of minor conditions can prevent much more costly repair.

 **Caution:** Do not immerse or soak the handset or the probe power plug.

### Inspecting and Cleaning an Optical Tip

- 1 – Check the optical tip for damage or contamination.
- 2 – Clean all external parts of the optical tip. Use glass cleaner or 70% alcohol-to-water solution and a pointed cotton swab.
- 3 – Clean only the internal threads of the optical tip. The internal optical lens should only be cleaned when troubleshooting an optical tip that provides poor focus.

 **Caution:** The internal optical lens is surrounded by an O-ring. Use care not to dislodge the O-ring.

 **Caution:** **Do not** use a cotton swab to clean the inside of the 3D phase measurement optical tips tip or damage to the tip may occur.

### Inspecting and Cleaning a Probe

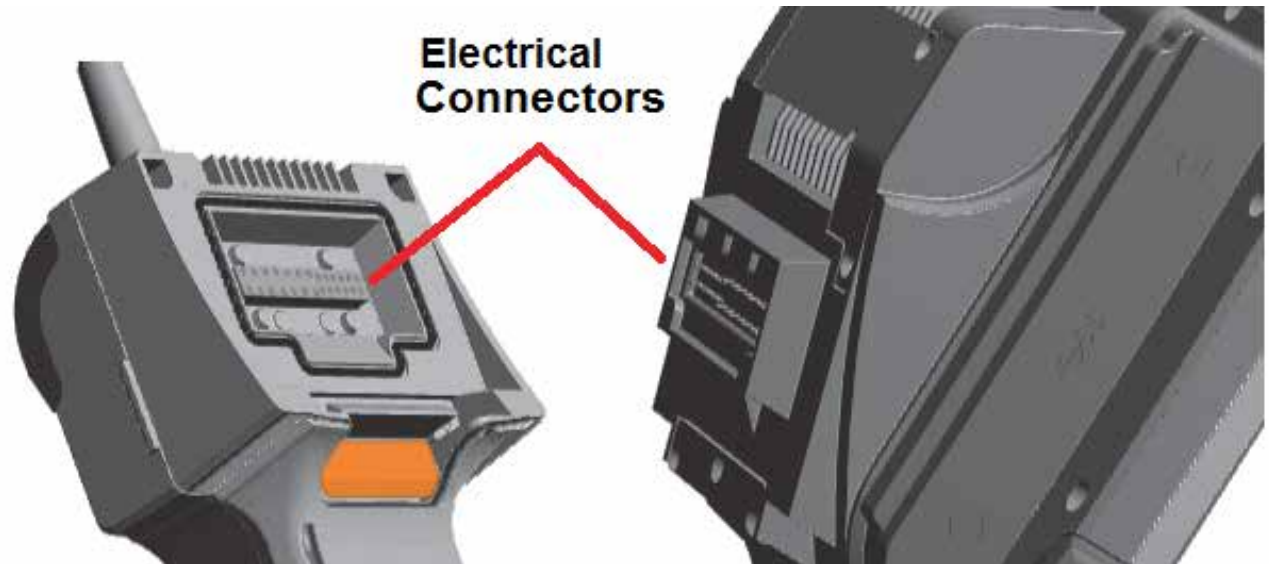
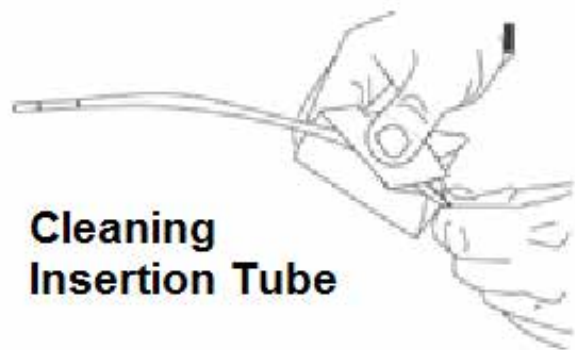
- 1 – Check the probe for damage or contamination. Look for excessive wear in the bending neck, loose strands of the braided weave, or separation of the bonding joints.



- 2 – Clean the probe tip, including the lens on the camera head. Use glass cleaner or 70% alcohol-to-water solution and a pointed cotton swab.



- 3 – Clean the rest of the probe, including insertion tube and fiberoptic connector. Use a soft cloth dampened with glass cleaner or 70% alcohol-to-water solution.



### Inspecting and Cleaning the Handset

- 1** – Disconnect the power cord from the power source.
- 2** – Check for damage or contamination, including any bent pins on the electrical connector.
- 3** – Use a soft cloth dampened with glass cleaner or 70% alcohol-to-water solution to clean all parts of the handset, except the electrical connector. Use great care when cleaning the electrical contact pins of the connector. Carefully clean the contact pins with glass cleaner or 70% alcohol-to-water solution using a cotton swab. Compressed air may be used to dry or remove debris from the electrical connector.

# Troubleshooting Guide

## Image

Condition	Causes	Actions
Images are distorted or blurred within normal range.	<ul style="list-style-type: none"> <li>Optical tip is not threaded onto the camera head securely.</li> <li>The optical surfaces are dirty.</li> <li>No tip optic or head guard is installed on camera tip.</li> </ul>	<p>Reinstall the optical tip. See <a href="#">"To Attach an Optical Tip"</a></p> <ul style="list-style-type: none"> <li>Clean the optical tip and the camera head. See <a href="#">"Inspecting and Cleaning an Optical Tip"</a> and <a href="#">"Inspecting and Cleaning a Probe"</a></li> <li>The Visual iQ 6.1mm diameter probes require the use of the 6.1mm headguard supplied. This headguard is unique to the Visual iQ 6.1mm in that it contains an aperture unlike previous product generations.</li> <li>Remove the tip optic.</li> <li>Try a different tip optic.</li> </ul>
Image quality is otherwise poor.	Various	<ul style="list-style-type: none"> <li>If available connect a different probe to handset.</li> <li>If image quality issue is associated with a specific probe contact GE Inspection Technologies to obtain a return material authorization (RMA).</li> </ul>
No image appears in the display.  (Hard Keys are lit)	Various	<ul style="list-style-type: none"> <li>Verify that the probe is properly seated and latched. See <a href="#">"To Install a Probe"</a></li> <li>Reboot system.</li> <li>If available connect a different probe to handset.</li> <li>If image quality issue is associated with a specific probe contact GE Inspection Technologies to obtain a return material authorization (RMA)</li> <li>Point the probe tip toward a bright light and see if image appears. If image appears, the problem is associated with lamp operation. If still no image, contact GE Inspection Technologies to obtain a return material authorization (RMA).</li> <li>If a Displayport cable was purchased connect to a Displayport capable monitor. Determine whether an image appears on it.</li> </ul>
Dark video image	Various	<ul style="list-style-type: none"> <li>Clean the optical tip and the camera head. See <a href="#">"Inspecting and Cleaning an Optical Tip"</a> and <a href="#">"Inspecting and Cleaning a Probe"</a></li> <li>Verify the LCD Brightness is properly adjusted for the ambient condition.</li> <li>Check the insertion tube and bending section for severe kinks or dents.</li> <li>No LED operation</li> </ul>
Frozen image "jitters" or is blurred.	<ul style="list-style-type: none"> <li>Probe tip was moving when image was captured.</li> </ul>	<ul style="list-style-type: none"> <li>Unfreeze then refreeze the image, keeping probe tip steady.</li> </ul>

## Probe

Condition	Causes	Actions
Reduced articulation in the bending neck.		
Bending neck is not articulating.	<ul style="list-style-type: none"><li>System is in an articulation-disabling mode such as Steer-and-Stay, freeze frame, File Manager, or any Menu function</li></ul>	<ul style="list-style-type: none"><li>Exit the articulation-disabling mode.</li><li>Power down the Visual iQ. Leave the system off for at least 15 seconds so that it can complete its shutdown sequence. Then turn it back on.</li></ul>
Insertion tube does not freely withdraw from the storage reel.	<ul style="list-style-type: none"><li>Insertion tube is stuck.</li></ul>	<ul style="list-style-type: none"><li>Gently push the insertion tube in and out with a slight twisting motion in order to free the probe. If probe cannot be freed contact GE Inspection Technologies Tech Support.</li></ul>

## Handset

Condition	Causes	Actions
Odd behavior or limited functions.	Various	<ul style="list-style-type: none"><li>Reboot system.</li></ul>
Reduced light output	<ul style="list-style-type: none"><li>High-temperature operation will cause system to automatically limit LED power.</li><li>No fan operation</li></ul>	<ul style="list-style-type: none"><li>If reduced light output is acceptable, normal use may continue. If greater light output is required, power system down and allow to cool.</li><li>Verify that both fans are operating. Clean with compressed air to remove dirt, and debris.</li></ul>
Reduced system response speed	<ul style="list-style-type: none"><li>High-temperature operation will cause system to automatically limit Microprocessor power.</li><li>No fan operation</li></ul>	<ul style="list-style-type: none"><li>If reduced processing speed is acceptable, normal use may continue. If greater processing speed is required, power system down and allow to cool.</li><li>Verify that both fans are operating. Clean with compressed air to remove dirt, and debris.</li></ul>
Automatic over-temp shutdown	<ul style="list-style-type: none"><li>Over-temp shutdown</li><li>No fan operation</li></ul>	<ul style="list-style-type: none"><li>Allow system to cool adequately prior to power-up.</li><li>Verify that both fans are operating. Clean with compressed air to remove dirt, and debris.</li></ul>
Erratic touchscreen behavior	<ul style="list-style-type: none"><li>Lack of grounded AC power</li></ul>	<ul style="list-style-type: none"><li>Remove charger from handset to determine if erratic behavior is caused by AC charger.</li><li>Connect charger to known "good" grounded outlet.</li></ul>

## Power

Condition	Causes	Actions
When plugged into AC power, system will not charge.	<ul style="list-style-type: none"><li>• No AC power present</li><li>• Incorrect charger</li><li>• Defective charger</li></ul>	<ul style="list-style-type: none"><li>• Check AC power source.</li><li>• Check power cable connections.</li><li>• Verify the correct charger is marked with 100 – 240V AC 50/60Hz 18VDC 3.34A.</li><li>• Contact GE Inspection Technologies for a replacement charger.</li></ul>
When plugged into AC power, system will not turn on.	<ul style="list-style-type: none"><li>• Incorrect charger</li><li>• Defective charger</li><li>• Defective Battery</li></ul>	<ul style="list-style-type: none"><li>• Verify the correct charger is marked with 100 – 240V AC 50/60Hz 18VDC 3.34A.</li><li>• Contact GE Inspection Technologies for a replacement charger.</li><li>• Try another battery.</li><li>• If replacement battery does not restore operation contact GE Inspection Technologies to obtain a return material authorization (RMA).</li></ul>
System runs when connected to AC power only.	<ul style="list-style-type: none"><li>• Battery disconnected or incorrectly connected.</li><li>• Battery low, not charging, depleted or defective.</li></ul>	<ul style="list-style-type: none"><li>• Disconnect and reconnect battery.</li><li>• Verify battery charge level.</li><li>• Recharge or replace the battery.</li></ul>

## Software

Condition	Causes	Actions
Time, date, or other settings are lost when system is turned off.	<ul style="list-style-type: none"><li>• Internal battery needs replacing. (Normal life is five years.)</li></ul>	<ul style="list-style-type: none"><li>• Return system to GE Inspection Technologies to have internal battery replaced. Contact GE Inspection Technologies to obtain a return material authorization (RMA).</li></ul>



# APPENDICES

## Appendix A. Technical Specifications

<b>Operating Temperature</b>	
Tip	-25°C to 100°C (-13°F to 239°F). Reduced articulation below 0°C (32°F)
System	-25° to 46°C (-13°F to 115°F). LCD may require warm-up period below 0°C (32°F).
<b>Storage Temperature</b>	
Relative Humidity	95% max, non-condensing
Waterproof	Insertion tube and tip to 14.7 psi (1 bar, 10.2 m of H <sub>2</sub> O, 33.5 ft of H <sub>2</sub> O).
Hazardous Environments	Not rated for use in hazardous environments.
<b>Camera</b>	
Diameter Probe	4.0 mm (0.16"), 6.1 mm (0.24"), 8.4 mm (0.33")
Image Sensor	1/6" Color SUPER HAD™ CCD camera (6.1 mm, 8.4 mm) 1/10" (4.0 mm)
Pixel Count	440,000 pixels
Housing	Titanium
<b>System</b>	
System Dimensions	17.1 cm x 19.7 cm x 38.1 cm (6.75" x 7.75" x 15")
Case Dimensions (Small, standard)	35.0 cm x 54.5 cm x 23.0 cm (13.78" x 21.46" x 9.05")
Case Dimensions (Large, optional)	57.2 cm x 56.3 cm x 41.2 cm (22.52" x 22.16" x 16.22")
System Weight	In small case with contents: 10.2 kg (22.4 lbs). In large case with contents: 19.6 kg (43.2 lbs). Out of Case: 6120 system - 3.0 kg (6.7 lbs). 6110 system - 4.0 kg (8.7 lbs).
Construction	Magnesium and Polycarbonate housing with integrated elastomeric bumpers
LCD Monitor	Integrated (6.5") active matrix XGA color LCD, daylight readable display, with optically-bonded, multipoint capacitive Dragontrail™ touchscreen.
Joystick Control	360° All-Way® tip articulation, menu access, and navigation
Button Set	Access user functions, measurement, and digital functions
Audio	Integrated 3.5mm headset / microphone jack or bluetooth headset
Internal Memory	16 GB SSD for user storage

Data I/O Ports	Two USB 3.0 host 'A' ports, one USB 3.0 client micro 'B' port,
Video Out	DisplayPort
Brightness Control	Auto and Variable
Illumination Type	White LED
Long Exposure	Auto - up to 16 seconds
White Balance	Factory default or user defined
Wi-Fi Adapter	802.11a/b/g/n, 2x2
Bluetooth Adapter	Bluetooth 4.0
Operating Frequency Bands and Output Power	Please see Appendix Q, page 111
Modulations	DSSS, OFDM
<b>Power</b>	
Lithium Ion Battery	10.8V (nominal), 73Wh, 6.8Ah
<b>Power Supply</b>	
AC	100-240VAC, 50-60Hz, <1.5A RMS
DC	18V, 3.34A
<b>Standards Compliance and Classifications</b>	
MIL-STD-810G	United States Department of Defense Environment Tests Sections 501.5, 502.5, 506.5, 507.5, 509.5, 510.5, 511.5, 514.5, 516.5, 521.5
MIL-STD-461F	U.S. Department of Defense -- Electromagnetic Interference RS103, RE102 - ABOVE DECK
Standards Compliance	Group 1, Class A: EN61326-1, UL, IEC, EN CSA-C22.2:61010-1, UN/DOT T1-T8
IP Rating	IP65 (Disassembled or Assembled)
<b>Patent Information</b>	
Mentor Visual iQ is covered under one or more of the following US Patents: US5734418, US5754313, US6468201, US7819798, US8310533, US8368749, US7262797, US7782453, US8514278, US8213676, US7821649, US8107083, US8422030, US7969583, US8253782, US7902990, US8310604, US8165351, US8760447, US8411083, US7170677, US7564626, US8810636, US8863033, US8976363, US9036892, and US9013469.	
<b>Software</b>	

Operating System	Embedded, multi-tasking operating system
User Interface	Menu-driven and soft button operation; menu navigation using either touchscreen or joystick
File Manager	Embedded file manager supports the following operation on files and folders: copy, cut, create, rename, delete, filter and sort. USB and internal flash storage.
Audio Data	PC compatible AAC (.m4a) file format
Image Control	Invert, Inverse+, Adaptive Noise Reduction, Distortion Correction, Illumination, Brightness, Long Exposure, Single View, Zoom (5x digital), Image Capture and Recall
Digital Zoom	Continuous (5x)
Image Formats	Bitmap (.BMP), JPEG (.JPG)
Video Format	MPEG4 AVC /H.264 (.MP4)
Text Annotation	Built-in full-screen text overlay generator
Graphic Annotation	User placement of arrows
Articulation Control	User-selectable steer vs. steer & stay articulation; tip "Home" return to neutral forward-tip orientation.
Software Updates	Field upgradable via USB ThumbDrive®
Languages	English, Spanish, French, German, Italian, Russian, Japanese, Korean, Portuguese, Chinese, Polish, Hungarian, Finnish and Swedish
Application Software	Menu Directed Inspection (MDI) software digitally guides inspectors through the inspection process, intelligently names files and creates MS Word® and PDF compatible inspection reports.
<b>Probe Measurements</b>	
Diameter	Length
4.0 mm (0.15")	2.0, 3.0 m (6.6, 9.8 ft.)
6.1 mm (0.24") or 8.4 mm (0.33")	2.0, 3.0, 4.5, 6.0, 10.0 m (6.6, 9.8, 14.8, 19.7, 32.8 ft.)
Longer lengths up to 30 m are available. Contact your sales representative for details.	
<b>Tip Articulation</b>	
Insertion Tube Length	Articulation
2 m - 4.5 m	Up/Down 160° min, Left/Right 160° min
6 m - 10 m	Up/Down 140° min, Left/Right 140° min
<b>Note: Typical articulation exceeds minimum specifications.</b>	

## Appendix B. Optical Tip Table

### Mentor Visual iQ 4.0mm tips

Part No.	Color	FOV (deg)	DOF mm	(in.)
<b>Forward View</b>				
T4080FF*	None	80	35-inf	(1.38-inf)
T40115FN	Black	115	4-inf	(.16-inf)
<b>Side View</b>				
T40115SN	Red	115	1-30	(.04-1.18)
T40120SF	Blue	120	6-inf	(.24-inf)
<b>Stereo Measurement</b>				
TM405555FG	Black	55/55-FWD	5-inf	(.20-inf)
TM405555SG	Blue	55/55-SIDE	4-inf	(.16-inf)

\* Indicates tip with maximum brightness.

### Mentor Visual iQ 6.1mm tips

Part No.	Color	FOV (deg)	DOF mm	(in.)
<b>Forward View</b>				
T6150FF	None	50	50-inf	(2.36-inf)
XLG3T6150FG	White	50	12-200	(.47-7.87)
XLG3T61120FG	Black	120	5-120	(.20-4.72)
XLG3T6180FN	Orange	80	3-20	(.12-.79)
XLG3T6190FF	Yellow	90	20-inf	(.79-inf)
XLG3T6150FB	Purple	50(45 DOV)	12-80	(.47-3.15)
T6165FF*	Orange & Blue	65	65-inf	(2.56-inf)
<b>Side View</b>				
XLG3T6150SF	Brown	50	45-inf	(1.77-inf)
XLG3T6150SG	Green	50	9-160	(.35-6.30)
XLG3T61120SG	Blue	120	4-100	(.16-3.94)
XLG3T6180SN	Red	80	1-20	(.04-.79)
<b>3D Phase Measurement</b>				
XLG3TM61105FG	Black	105	8-250	(.31-9.84)
XLG3TM61105SG	Blue	105	7-250	(.27-9.84)
<b>Shadow Measurement</b>				
XLG3TM6150FG	White	50-FWD	12-30	(.47-1.18)
XLG3TM6150SG	Blue	50-SIDE	7-24	(.28-.94)
<b>Stereo Measurement</b>				
XLG3TM616060FG	Black	60/60-FWD	4-80	(.16-3.15)
XLG3TM615050SG	Blue	50/50-SIDE	2-50	(.08-1.97)

\* Indicates tip with maximum brightness.

### Mentor Visual iQ 8.4mm tips

Part No.	Color	FOV (deg)	DOF mm	(in.)
<b>Forward View</b>				
XLG3T8440FF*	None	40	250-inf	(9.84-inf)
XLG3T8480FG	Yellow	80	25-500	(0.98-19.7)
XLG3T84120FN	Black	120	5-200	(0.20-7.87)
XLG3T8440FG	White	40	80-500	(3.15-19.7)
<b>Side View</b>				
XLG3T8440SF*	Brown	40	250-inf	(9.84-inf)
XLG3T8480SG	Green	80	25-500	(0.98-19.7)
XLG3T84120SN	Blue	120	4-200	(0.16-7.87)
<b>Stereo Measurement</b>				
XLG3TM846060FG	Black	60/60-FWD	4-50	(0.16-1.97)
XLG3TM846060SG	Blue	60/60-SIDE	4-50	(0.16-1.97)

\* Indicates tip with maximum brightness.

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## Appendix C. Chemical Compatibility

Chemical compatibility refers to the probe's ability to come into contact with various liquid substances and not be damaged.



**WARNING** Do not use this system in explosive environments.

These substances are safe for a short duration of contact with the insertion tube and tip optics:

- Water
- Aircraft Gasoline
- Jet-A-Fuel
- Isopropyl alcohol
- JP-4 Fuel
- Kerosene
- Synthetic Turbo Oil
- Gasoline
- Diesel Fuel
- Hydraulic Oil
- Inhibited Transformer Oil

Subsequent to contact with the above fluids, the insertion tube and tip optics used must be cleaned prior to storage.

## Appendix D. Warranty

GE Inspection Technologies warrants its VideoProbe components, when new, to be free from defects in material and workmanship and to perform in accordance with manufacturer's specifications under normal use and service for a period of one year from the date of purchase from GE Inspection Technologies or its authorized distributors, except that, the light source is warranted for a period of 3 years from the date of purchase, the battery is warranted for a period of 30 days from the date of purchase, and where used, servo motors in the articulation drive system are warranted for the life of this VideoProbe product.

GE Inspection Technologies' obligation under this warranty is limited to the repair or replacement of components determined by GE Inspection Technologies to be defective within the warranty period at no cost to the original purchaser, except for return shipping expenses. It shall be the purchaser's responsibility to return the product to GE Inspection Technologies or one of its authorized service centers. The warranty does not cover accessories or optional equipment not manufactured by GE Inspection Technologies, but these items may be covered by separate manufacturers' warranties.

This warranty extends to the original purchaser and cannot be assigned or transferred to any third party. This warranty shall not apply to any damage or product failure determined by GE Inspection Technologies to have been caused by misuse, accident (including shipping damage), neglect, improper maintenance, modification or repair by someone other than GE Inspection Technologies or one of its authorized service representatives.

These express warranties are in lieu of any other warranties, express or implied, including the warranties of merchantability and fitness for a particular purpose, and no other person has been authorized to assume for GE Inspection Technologies any other liability in connection with the sale of its VideoProbe products. GE Inspection Technologies shall not be liable for any loss or damages, whether direct or indirect, incidental, or consequential, resulting from the breach of any express warranty set forth herein.



## Appendix E. Verifying Measurement Tips

Verify measurement tips each time you use them to ensure that no mechanical damage has degraded their accuracy. Visual IQ systems are shipped with a measurement verification block. This tool lets you verify the accuracy of measurement tips. It contains optical measurement targets whose accuracy is traceable to the United States National Institute of Standards and Technology (NIST) measurement standards.

These are the part numbers for the verification blocks used with the Visual IQ:

VER2400C	For 4.0 mm systems
VER2600D	For 6.1 mm systems
VER2600E	For 6.1 mm systems
XLG3TM84VER	For 8.4 mm systems

### To Verify a 3DPM Measurement Tip:

Securely attach a 3DPM tip and then

- 1 – Navigate to the Measurement & Annotation section of the Settings menu and select Verify.
- 2 – Insert the tip into the verification block and follow the on-screen prompts to complete the test. The system will automatically check the tip's accuracy, check for contamination on the gratings, and verify the health of the tip LEDs. Note that the results of this automatic verification are logged in a file for troubleshooting (if required).

**Note:** Accuracy may also be checked by performing manual length measurements between the crosshairs.

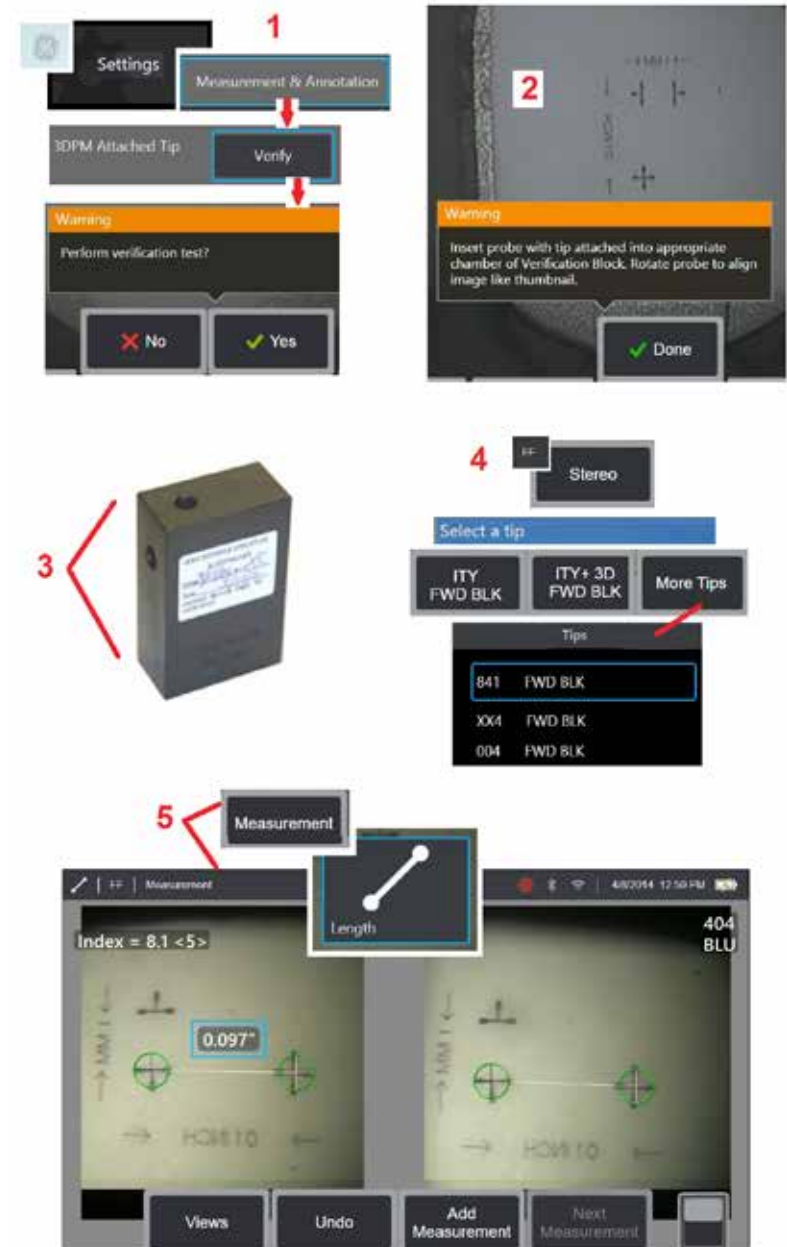
### To Verify a 3D Stereo or Stereo Measurement Tip:

Securely attach a 3D Stereo or Stereo tip and then

- 3 – Insert the tip into the appropriate port of the verification block and position the tip to center the target crosshairs in the image.
- 4 – Freeze the image, select Stereo, and then identify the serial number or the attached tip.

**Note:** 3D Stereo tips include a + 3D designation on the soft key.

**Note:** When verifying legacy stereo measurements using a blue side stereo tip in a VER2600E block, an orange box will flash around the INDEX if below minimum set value.



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**5** – Perform manual length measurements between the crosshairs.

With accurate cursor placement, a measurement tip of any type in good condition should give results of  $0.100 \pm 0.005$  inches ( $1.00 \pm 0.05$  mm). If your measurement does not fall within these limits, try the suggestions under [Troubleshooting Measurements](#).

Each measurement verification block comes with a calibration schedule and a certificate of calibration (C of C), which notes the calibration date and due date.

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## Appendix F. Environmental Compliance



The equipment purchased has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in the environment and to diminish the pressure on the natural resources, we advise the use of appropriate take-back systems. Those systems will reuse or recycle most of the materials of end-life equipment in a sound way and are a requirement in many countries.

The cross-out wheeled bin symbol advises the use of recycling/take-back systems.

If more information is needed on the collection, reuse, and recycling systems, please contact the appropriate local or regional waste administration.

### EU Battery Directive

This product contains a battery that cannot be disposed of as unsorted municipal waste in the European Union. See the product documentation for specific battery information. The battery is marked with this symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling return the battery to your supplier or to a designated collection point.



### What do the markings mean?

Batteries and accumulators must be marked (either on the battery or accumulator or on its packaging, depending on size) with the separate collection symbol. In addition, the marking must include the chemical symbols of specific levels of toxic metals as follows:

Cadmium (Cd) over 0.002%

Lead (Pb) over 0.004%

Mercury (Hg) over 0.0005%

### The risks and your role in reducing them

Your participation is an important part of the effort to minimize the impact of batteries and accumulators on the environment and on human health. For proper recycling you can return this product or the batteries or accumulators it contains to your supplier or to a designated collection point. Some batteries or accumulators contain toxic metals that pose serious risks to human health and to the environment. When required, the product marking includes chemical symbols that indicate the presence toxic metals: Pb for lead, Hg for mercury, and Cd for cadmium. Cadmium poisoning can result in cancer of the lungs and prostate gland. Chronic effects include kidney damage, pulmonary emphysema, and bone diseases such as osteomalacia and osteoporosis. Cadmium may also cause anemia, discoloration of the teeth, and loss of smell (anosmia). Lead is poisonous in all forms. It accumulates in the body, so each exposure is significant. Ingestion and inhalation of lead can cause severe damage to human health. Risks include brain damage, convulsions, malnutrition, and sterility. Mercury creates hazardous vapors at room temperature. Exposure to high concentrations of mercury vapor can cause a variety of severe symptoms. Risks include chronic inflammation of mouth and gums, personality change, nervousness, fever, and rashes.

Visit [http://ec.europa.eu/environment/waste/weee/index\\_en.htm](http://ec.europa.eu/environment/waste/weee/index_en.htm) for take-back instructions and more information about this initiative.

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## Appendix G. Regulatory Compliance


### European Community — CE Notice:

The  mark indicates compliance with the essential requirements of Directive EU RED (2014/53/EU). Such marking is indicative that this equipment meets or exceeds the following technical standards:

EN 300 328  
EN 301 893  
EN 301 489-1/EN 301 489-17  
EN 62311

### European Equipment Classification

Group 1, Class A

The  mark on this product indicates it has been tested to and conforms with the provisions noted within the 2004/108/EC Electromagnetic Compatibility Directive. The Visual iQ system is in conformance with the following standard: EN61326-1.

Declarations of Conformity are held by GE Inspection Technologies GmbH:

GE Inspection Technologies  
GmbH Product Service Center  
Lotzenäcker 4  
72379 Hechingen Germany  
Tel: +49(0) 74719882 0  
Fax: +49(0) 74719882 16

### Safety Mark

The Visual iQ system is in compliance with the following standards:

UL 61010-1, IEC 61010-1, EN 61010-1 and CSA-C22.2 No. 61010-1.

### Additional Certification Testing

MIL-STD-461F: RS103, RE102–Above Deck  
MIL-STD-810G: 501.5, 502.5, 506.5, 507.5, 509.5, 510.5, 511.5, 514.5, 516.5, 521.5  
UN / DOT T1-T8

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**FCC Compliance Statement:**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- 1) This device may not cause harmful interference and
- 2) This device must accept any interference received, including interference that may cause undesired operation.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interferences in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**FCC Caution:**

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**IMPORTANT NOTE:****FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

**Industry Canada Regulatory Statement:**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- 1) This device may not cause interferences, and
- 2) This device must accept any interferences, including interferences that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada exempts de licence standard RSS (s). L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes:

- 1) il ne doit pas produire de brouillage et
- 2) l'utilisateur du dispositif doit être prêt à accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fonctionnement du dispositif.

Complies with the Canadian ICES-003 Class B specifications.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.



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**Brazil Wireless Statement:**

Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferência prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário.

(This equipment operates on a secondary basis, ie, not entitled to protection against harmful interference, even of the same type stations, and cannot cause interference to systems operating on a primary basis.)

**South Korea Wireless Statement:**

이 기기는 업무용(A급)으로 전자파적합로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다

(EMC registration is done on this equipment for a business use only (Class A). Product seller and user should notice that this equipment is purposed to be used except for house use.)

당해 무선설비는 전파혼신 가능성이 있으므로 인명안전과 관련된 서비스는 할수 없음

(This device shall not be used for life-safety related service due to radio interference possibility.)

**Taiwan NCC Wireless Statement:**

注意！

依據 低功率電波輻射性電機管理辦法

第十二條 經型式認證合格之低功率射頻電機，非經許可，

公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；  
經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信規定作業之無線電信。

低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

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## IMPORTANT NOTE:

### IC Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. The transmitter module may not be co-located with any other transmitter or antenna.

Cet équipement est conforme aux limites d'exposition aux rayonnements d'Industrie Canada établies pour un environnement non contrôlé.

Le module émetteur peut ne pas être co-située avec tout autre émetteur ou antenne.



### Caution:

This device for the band 5150-5250 MHz is only for indoor usage to reduce potential for harmful interference to co-channel mobile satellite systems.

Because high power radars are allocated as primary users (meaning they have priority) in 5250-5350 MHz and 5650-5850 MHz, these radars could cause interference and / or damage to license exempt LAN devices.

Cet appareil (pour réseaux locaux radioélectriques) dans les bandes de fréquences 5150-5250 MHz est réservé à une utilisation à l'intérieur afin de réduire le risque d'interférence avec les systèmes satellites mobiles bicanaux.

Les radars forte puissance sont désignés comme étant les premiers utilisateurs (c'est-à-dire qu'ils ont la priorité) des bandes de fréquences 5250-5350 MHz et 5650-5850 MHz. Ces stations radars peuvent provoquer des interférences et/ou des dommages à ce périphérique.

### Canadian Notice

This equipment does not exceed the Class A limits for radio noise emissions as described in the Radio Interference Regulations of the Canadian Department of Communications.

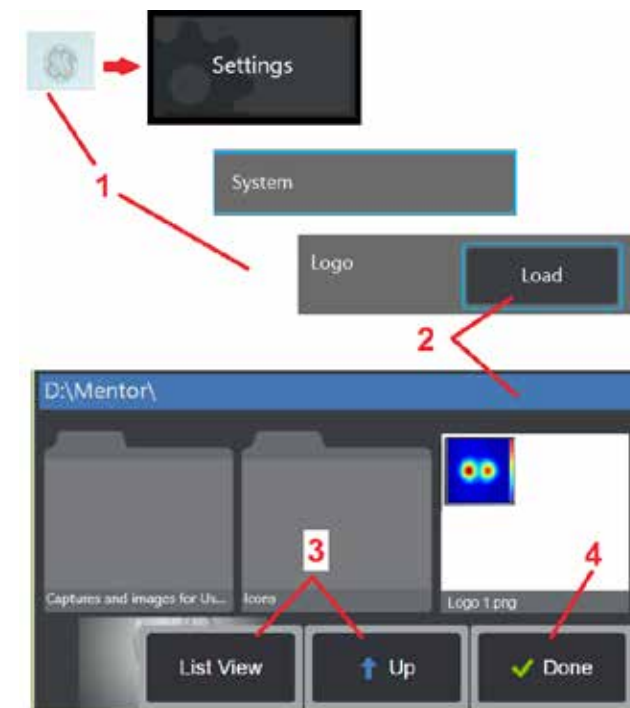
Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

## Appendix H. Creating a Personalized Logo File

A custom logo can be loaded into the display, where it will appear in the lower left corner (in place of the default GE logo). Suitable logos must be saved as **PNG** file format and must be no larger than 140 by 140 pixels. It is advisable to use image files that are approximately square. To replace the GE icon with a custom icon:

- 1** – Tap the lower-left corner of the display (typically contains a **GE Logo**) at any time to open the **Global Menu**, select **Setup** and then open the **System** menu. You can now choose to **Load a Logo**.
- 2** – Select to **Load a Logo**. This File Navigation window will open.
- 3** – Navigate to find the desired logo file.
- 4** – Choose the logo file and select Done. The newly loaded logo file appears at the bottom left of the display screen, provided it is configured to do so by the [Screen and Display Settings](#).

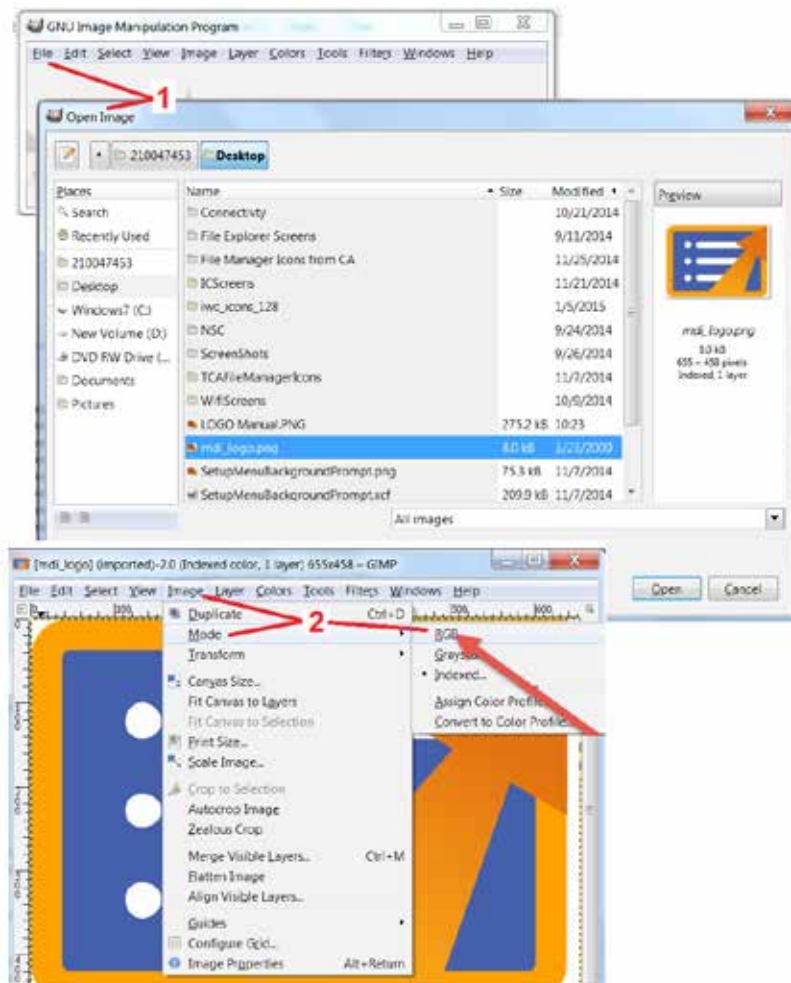
**Note:** See next page for instructions to incorporate a transparent logo.



To incorporate a transparent customized logo, you must first save the logo file in Photoshop, Gimp 2, or a similar graphics package capable of creating transparencies. If working in Gimp 2, follow the process below to convert a single-color image into a transparency.

1 – Select and **Open** the PNG file in Gimp2 as shown.

2 – Select **Image > Mode > RGB**.

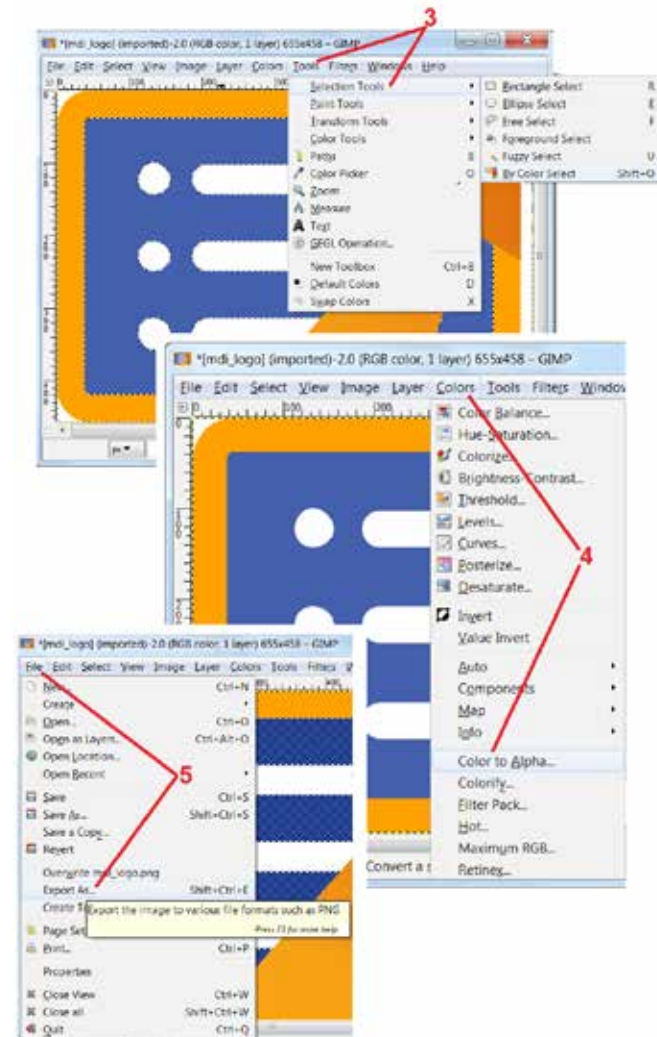


3 – Choose a single color.

4 – Select **Color to Alpha...** to convert the specified color to transparent.

5 – Export the transparent image to PNG file type.

You can now **Load** your transparent personalized logo into the Visual IQ.



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## Appendix I. Open Source Software Availability

There are various open source software packages that have been utilized within this product, and to meet license and copyright obligations, a copy of the source code for each package is available upon request, along with the individual licenses and copyright notices for each, for three years from the date of original installation upon the product.

Requesting these source packages is NOT REQUIRED for operation or use of this product. Additionally, only portions of software on this product fall under open source software licenses, with the remainder merely being an aggregation on the product's storage volumes. Thus NO promise is made NOR implied that source code will be provided for the aggregated proprietary software.

With respect to each open source software distribution, no warrantee is expressed nor implied by either the original authors of the software, nor by any other party involved in the distribution of the software. More explicit warranty disclaimers are detailed within the license documentation of each software package, again available upon request. Furthermore such disclaimers and license requirements and restrictions only apply to each open source software package, and DO NOT REFLECT the warranty of the product as a whole.

There are no additional restrictions placed upon copying, distribution, or modification of each software package beyond those of the original licenses, expressed or implied, due to their inclusion in this product.

To request a copy of these open source software packages, please have your product model and serial numbers ready, and call customer support representatives at +1 (315) 554-2000, option 3.

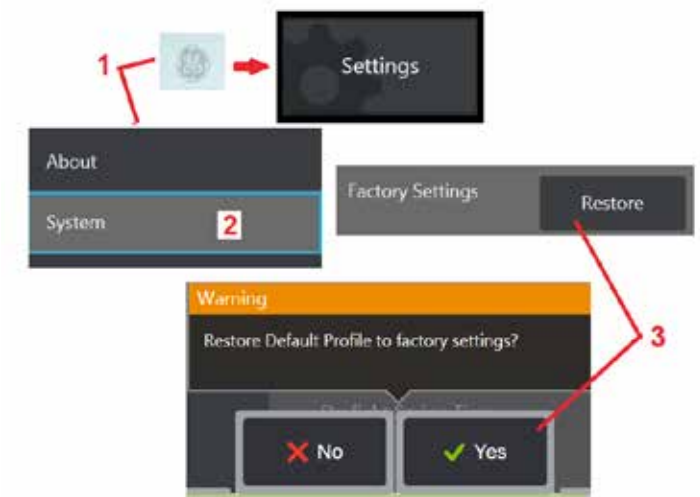
## Appendix J. Restoring Factory Settings

**1** – Tap the on-screen **GE Icon** at any time to open or close the **Global Menu**, which provides access to several features including the **Settings Menu**.

**2** – Tap to open the **Settings Menu**.

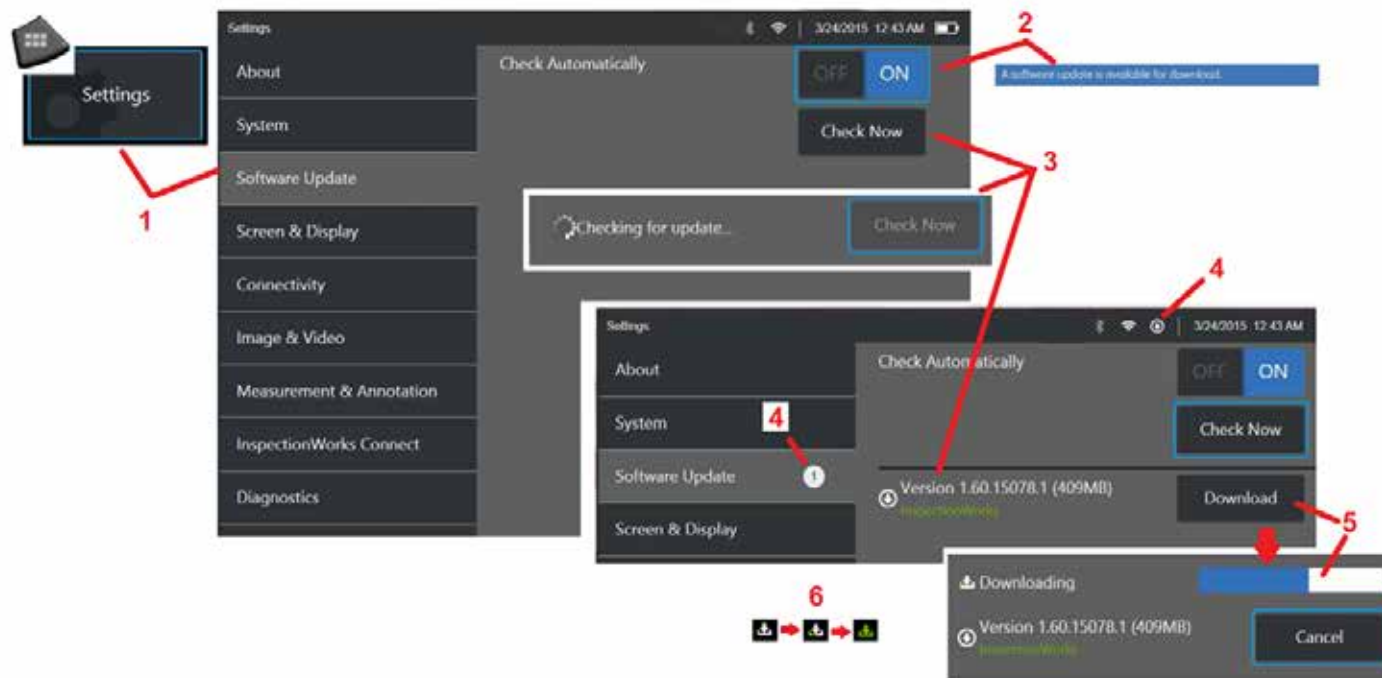
**3** – Select Restore, then confirm by selecting Yes to reset all values of the active profile to the factory default values ([Click here to learn more about changing the current profile or creating a new one](#)).


**Note:** Restoring factory defaults will automatically cause the operating language to revert to English. [Click here to learn how to change the operating language selection](#).



## Appendix K. Updating Mentor Visual iQ Software

Software updating requires a connected USB drive or an Internet connection. The updating process must be carried out while the iQ is connected to an AC power source.



- 1 – Tap the logo at the lower left corner of the screen or press  to open the **Global Menu**, select the **Settings Menu**, then choose **Software Update**.
- 2 – When set to **On**, device periodically checks for available updates on a connected USB drive and whenever connected to the Internet. This status message appears when updates are detected.
- 3 – Select to immediately search for available updates on a connected USB drive and/or via the Internet connection.
- 4 – Status-bar icon appears when software update is available for download while this counter indicates the total number of **new** updates available
- 5 – Select to **Download** an update via the Internet connection. This status-bar icon (6) indicates download progression. Once downloaded (or if the update is found on a USB drive), you will be prompted to **Install** the upgrade before software modification begins.

**Note:** Updating the software will not affect files stored in the File Manager, Profiles, or other settings made by the operator.



---

## Appendix L. LongSteer™ Specifications

Supply pressure: 100 – 150 PSIG

Do not exceed supply pressure of 150 PSIG

Dry air must be provided by the user.

To get full articulation, insertion tube must be extended at least 10 feet off the reel.

User is able to continue to inspect and steer while removing the probe from the reel. No need to remove the entire length of the probe from the reel prior to operation. This allows the user to only extend the length of probe needed to inspect the asset.

10mm/8.4mm Shaft:                      18m and 30m lengths available

10mm/6.1mm PM Shaft:                18m and 30m lengths available

---

## Appendix M. InspectionWorks Connect (IWC) Optional Collaboration Capability

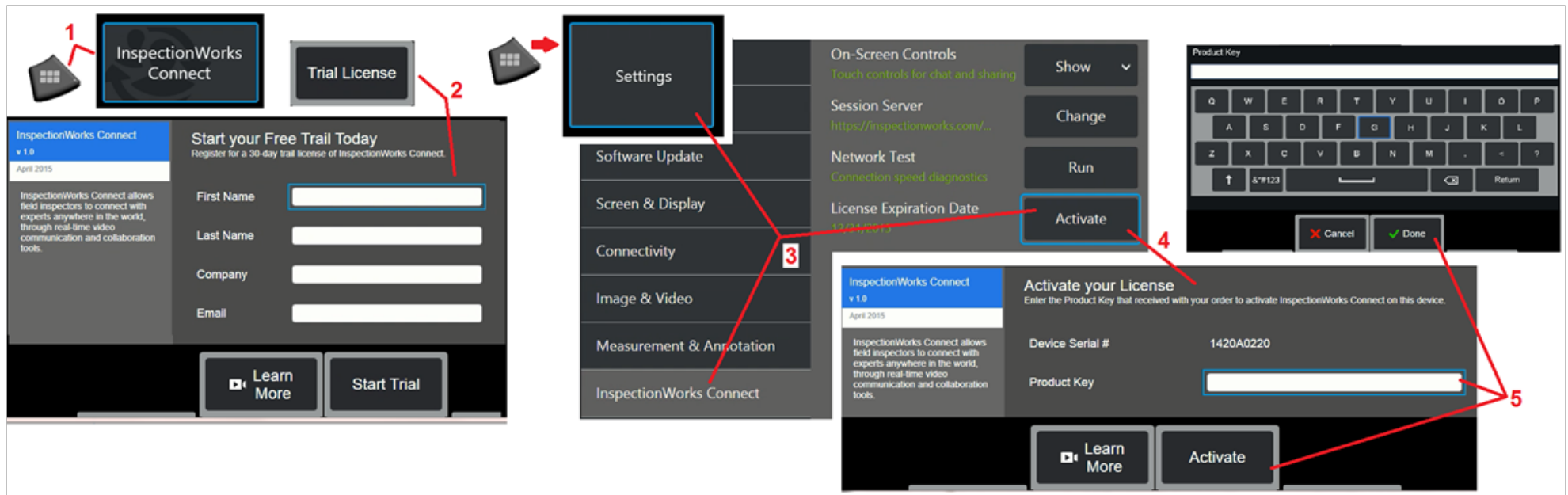
**InspectionWorks Connect** is an Internet service that enables video collaboration between Inspectors and remotely located Experts. Inspectors control their Visual iQ while simultaneously connecting through the IWC cloud infrastructure to a remote Expert via the IWC web portal. This allows the Inspector and Expert to share inspection video, exchange chat messages, and make on-screen annotations (circles, text, arrows or freehand drawings), which are seen by both participants. Collaborating with an IWC session requires:

- Ensuring your Visual iQ is equipped with this optional feature
- Starting and Stopping a session
- Inviting an expert to participate and Expert Login (supported browser required)
- Using the Chat feature and other on-screen controls

### Equipping Your Mentor Visual iQ with the IWC Optional Capability

InspectionWorks Connect is an optional feature ***enabled at the time your device is purchased or acquired after device delivery***. To purchase the IWC capability, contact your local GE salesperson or call Customer Care at 1-866-243-2638. You can also contact us using our online contact form, <https://inspectionworks.com/support>. You may obtain a 30-day trial license, which allows full access to IWC's capabilities.

***IWC requires a Wi-Fi, wired, or cellular Internet connection and an MViQ software version of 1.5 or newer.***



**1** – Tap the logo at the lower left corner of the screen or press  to open the **Global Menu**, then select **InspectionWorks Connect**.

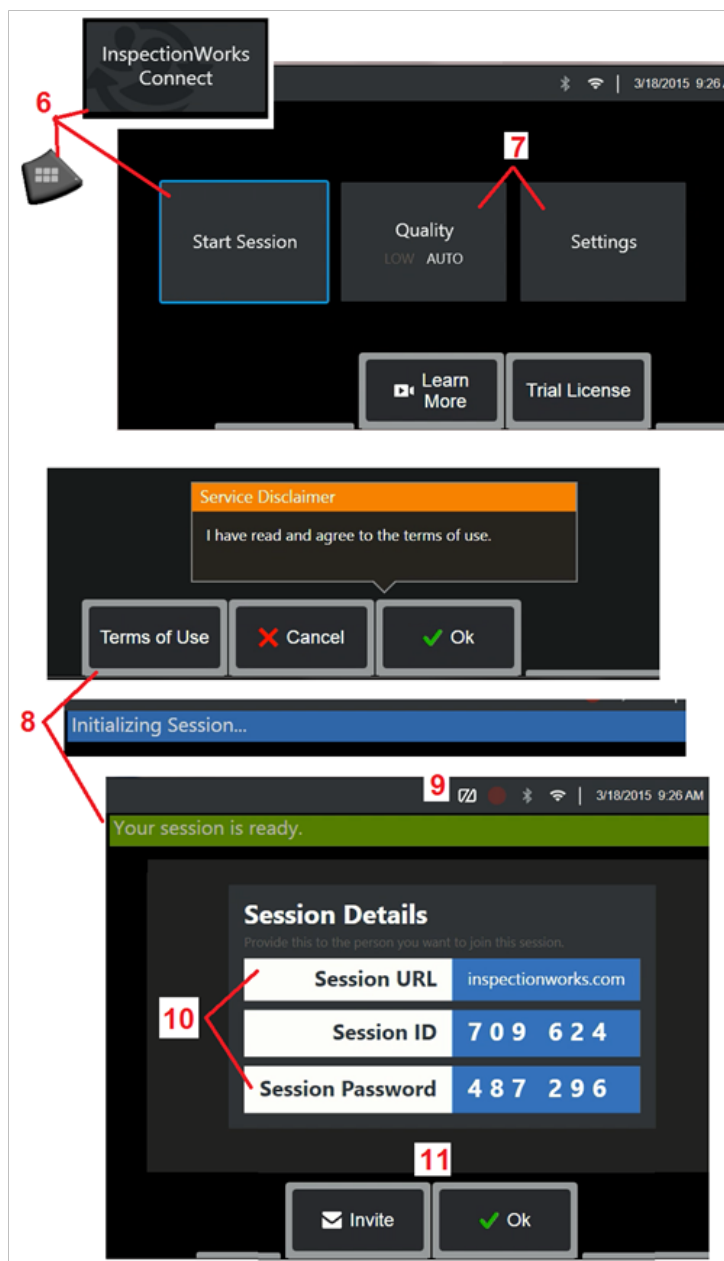
*Note: If your device has already been equipped with IWC capability, the Start Session screen will display and you can begin an IWC session.*

**2** – Select and enter the required information to begin a 30-day trial session or contact GE (see information above) to purchase the IWC capability.

**3** – To active IWC capabilities purchased after device delivery, select **InspectionWorks Connect** in the **Settings** menu.

**4** – Select **Activate** to enter your product key. Other selections allow you to turn on-screen IWC controls **On** or **Off**, specify the **Server** through which the IWC session occurs, run a **Network Test** to determine if the network connection is sufficient to support IWC communication, and check when your trial activation ends.


**5** – Touch to enter the **Product Key**. The **Virtual Keyboard** will display. Select **Done** after entering the key, then **Activate** to complete the IWC-enable process.



## Starting and Stopping an IWC Session

**InspectionWorks Connect** is an Internet service that enables video collaboration between an Inspector and a remotely located Expert. Inspectors control their Visual IQ, sharing inspection video, exchanging chat messages, and making on-screen annotations seen by both participants. InspectionWorks Connect is an optional feature *enabled at the time your device is purchased or acquired after device delivery*.

To begin an IWC session:

**6** – Tap the logo at the lower left corner of the screen or press  to open the **Global Menu**, then select **InspectionWorks Connect**.

*Note: As long as your device has already been equipped with IWC capability, the Start Session screen will display and you can begin an IWC session. If it does not, [click here to learn more about Equipping Your Mentor IQ with IWC](#).*

**7** – Select **AUTO** or **LOW** image **Quality** (a **LOW** setting allows for streaming video over a network with limited bandwidth) or **Settings** to turn on-screen IWC controls **On** or **Off**, specify the **Server** through which the IWC session occurs (not a task you will normally perform), run a **Network Test** to determine if the network connection is sufficient to support IWC communication, and **Activate** IWC (or check when your trial activation ends).

**8** – After reading the **Terms of Use**, select **Ok** to start your session.

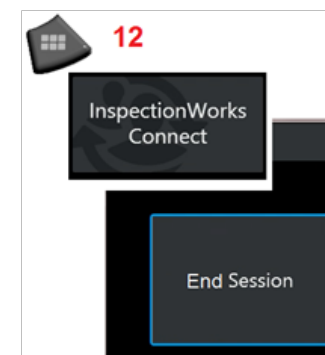
**9** – This icon appears when an IWC session is enabled but the screen is not currently being shared with an expert.

**10** – This session URL, identification, and password are required by anyone joining the session as a remote **Expert**. Only one Expert at a time can participate in a session. Automatically deliver this log-in information to any email address by selecting **Invite** (**11**). Alternatively, select **Ok** to begin your session without automatically inviting an Expert.

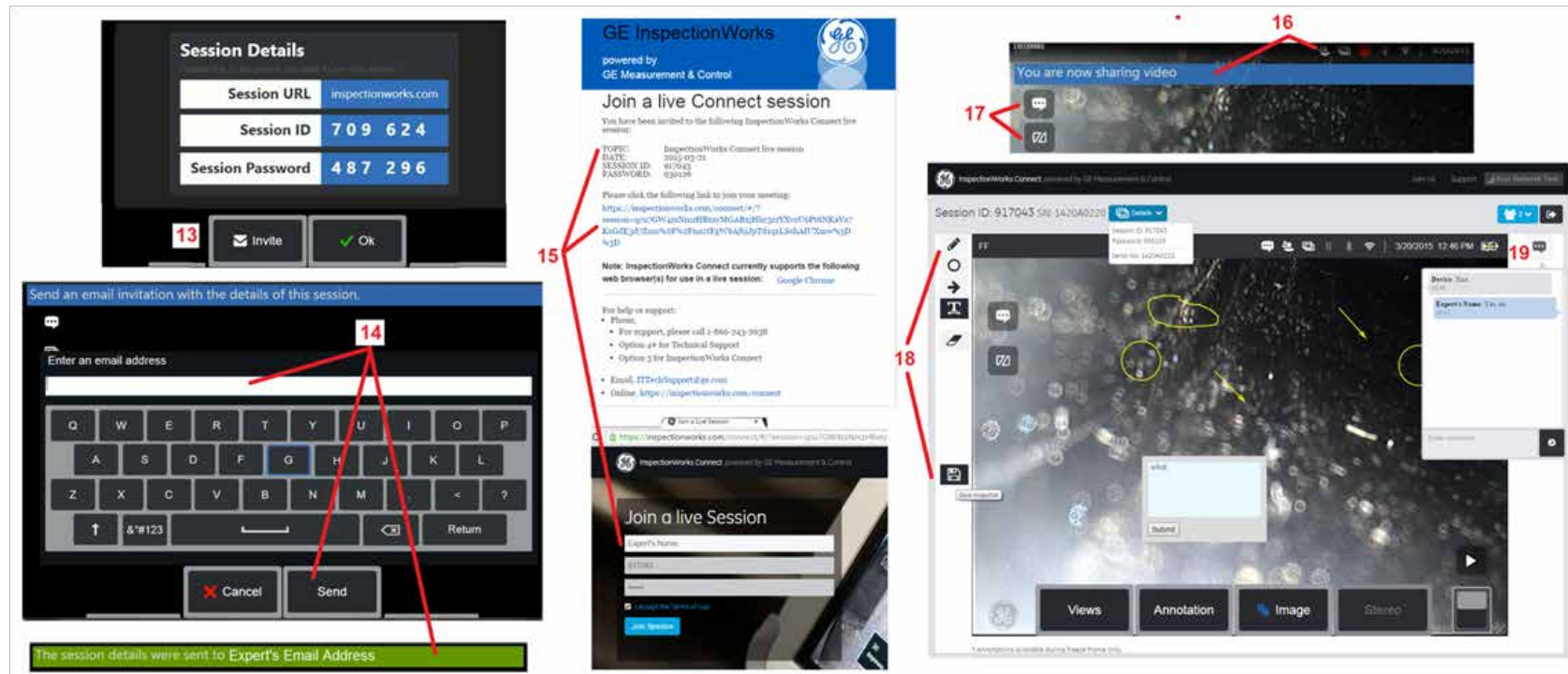
*Note: A session URL, ID, and password can be shared with an Expert who can then log into the Expert portal and connect to your session. This can be accomplished automatically by selecting the Invite button. To manually log into an IWC session, anyone with a supported web browser can simply go to <https://inspectionworks.com/connect/> or click on the Join a Live Connect Session button on the InspectionWorks home page. They need only input the inspector-provided ID and Password to complete the process.*

To end an IWC session:

**12** – To stop a session at any time, open the **Global Menu**, then select **InspectionWorks Connect**. Select the **Stop Session** button.



## Emailing an Invitation to Join an IWC Session and Expert Login



**13** – Select **Invite** to specify the email address of an **Expert** to whom you wish to automatically deliver the session URL, identification, and password.

**14** – Input the **Expert's** email address and select **Send**. All required login information and a link to the IWC website will be automatically included in the email.

**15** – After receiving this invitation email, the **Expert** needs only to click on the included link, input an on-screen name, and select **Join Session**.

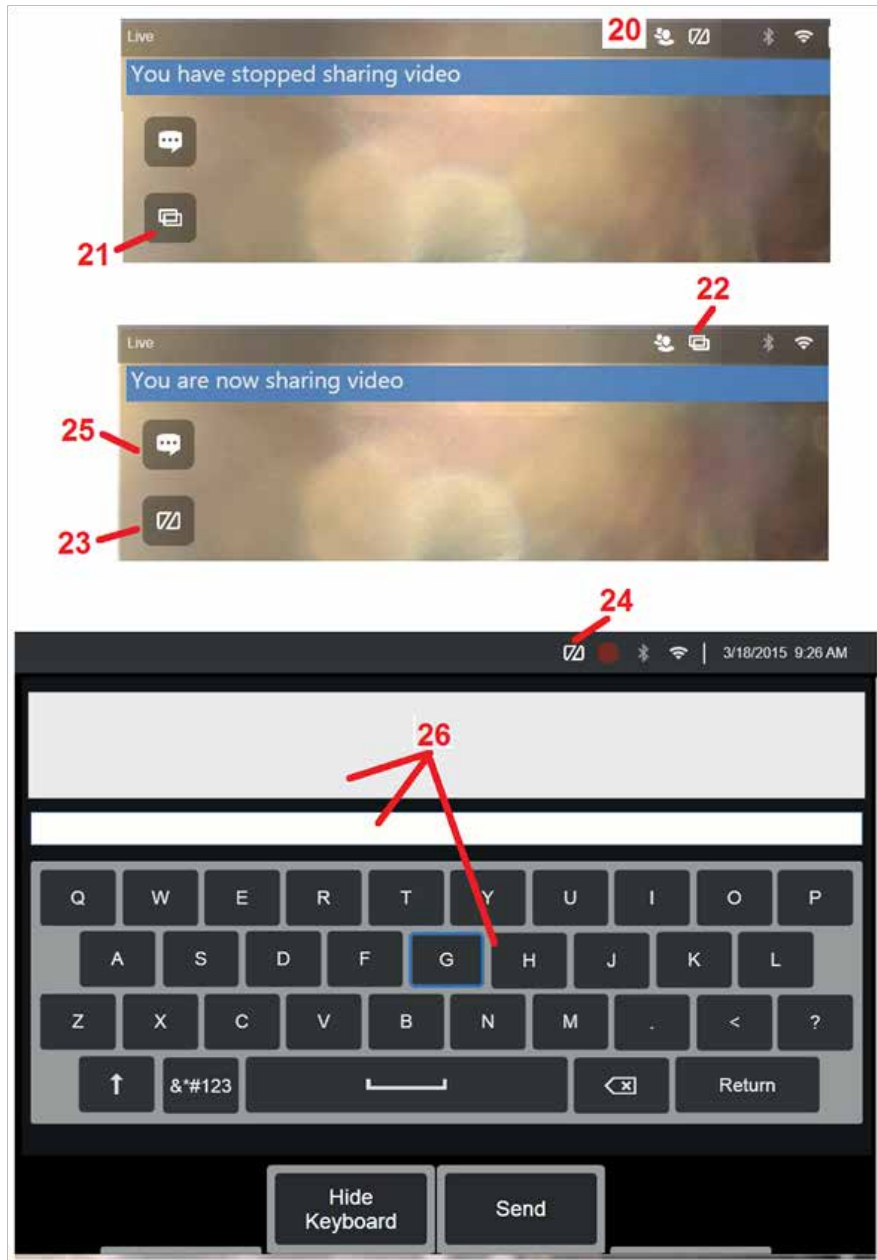
**Experts can access IWC with any device capable of making an Internet connection and running a supported browser.**

**16** – This notification appears on the Visual iQ display when an **Expert** joins the session. This icon remains whenever an **Expert** is logged into the session.

**17** – Select the upper button to open the **Chat Box** and/or send a chat message. Select the lower button to stop sharing the displayed image with the logged-in **Expert**. Note that **stopping display sharing does not end the IWC session**. Touch here to toggle screen sharing **On** and **Off**.

**18** – **Expert** onscreen controls allow for free-hand drawing, insertion of circles and arrows, placement of text notes, and removal of annotated features. The Expert can also save screen captures to his or her computer. **Note: Expert on-screen controls are only functional when the Visual iQ display screen is frozen by the Inspector – Expert has no control over Visual iQ operation.**

**19** – **Expert** and Visual iQ **Inspector** can send and receive chat messages throughout the session, whether or not the display screen is currently shared.



## IWC Controls on the Visual iQ Inspector's Screen

**20** – This icon appears on the Visual iQ display when an **Expert** joins the session. Whether or not the displayed image is shared, this icon is displayed whenever an **Expert** is logged into the session.

**21** – Press here to share the displayed image with the logged-in **Expert**.

*Note: Only the Visual iQ Operator can control whether or not the displayed image can be viewed by the remotely located Expert.*

**22** – This icon indicates the displayed image can be viewed by the logged-in **Expert**.

**23** – Press here to stop sharing the displayed image with the logged-in **Expert**. *Note: stopping display sharing does not end the IWC session.*

**24** – This icon indicates the displayed image can not be viewed by the logged-in **Expert**.

**25** – Select to open the **Chat Box**. Note that **Expert's** chat messages momentarily appear on the Visual iQ's display screen and remain viewable throughout the session by opening the Chat Box.

**26** – **Expert** and Visual iQ **Inspector** can send and receive chat messages throughout the session, whether or not the display screen is currently shared.



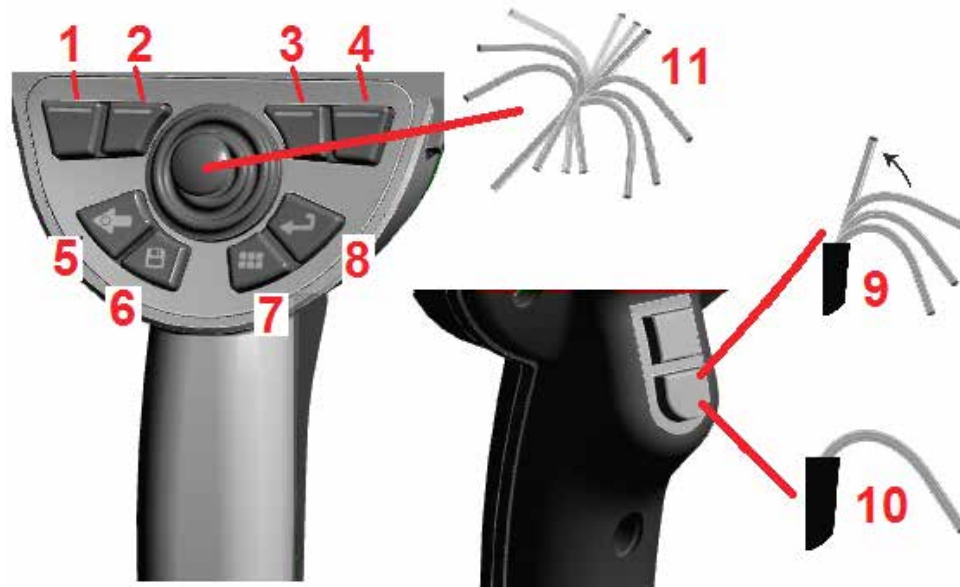
## Appendix N. InspectionWorks Insight

InspectionWorks Insight makes it easy to securely store, share and manage all your inspection and maintenance data. Upload and manage files directly from your device or through our web-based application. Insight provides tools to organize inspection data, search/filter on key attributes, analyze, create customer reports and share content with others.

Go to <https://inspectionworks.com/insight> or email [inspection.works@ge.com](mailto:inspection.works@ge.com) to learn more.

## Appendix O. Controlling the iQ with a Keyboard

Connecting a wireless Bluetooth or USB-wired keyboard allows for remote control of Visual iQ functions and probe articulation. Following is a list of function key and key-press combinations that are equivalent to the iQ button and joystick operations.



	MViQ Operation	Press on Keyboard
1	Far Left Soft Key	FN & F1
2	Middle Left Soft Key	FN & F2
3	Middle Right Soft Key	FN & F3
4	Far Right Soft Key	FN & F4
5	Back	F5
6	Save	F6
7	Menu	F7
8	Freeze/Enter	F8
9	Steering Home	Alt & FN & F12
10	Steer-and-Stay	FN & F12
11	Probe Articulation	Arrow Keys
	Save As	Alt & FN & F6
	Toggle Soft Key Rows	Alt & FN & F7
	Back to Live Screen	Alt & F5

---

## Appendix P. Controlling the iQ with an iPad

*Connecting a iPad running iOS 8 or above to the MViQ allows users to control the system from a distance.*

Prior to being able to use an iPad as a remote for the MViQ system, iTunes will need to be installed on the system. Below are the steps to do so:

1. Download the 64-bit version of the iTunes installer and copy it to a USB drive. This can be downloaded from <https://www.apple.com/itunes/download/>
2. Insert the USB drive into the MViQ system.
3. Select iTunes64Setup.exe from the USB drive via the MViQ's File Manager
4. Accept the installation prompt
5. Upon completion, the system will reboot, install iTunes components necessary for iView Remote to function, and reboot a final time to the MViQ UI with the message, "Third party software was successful."

The iView Remote will also have to be downloaded onto the iPad.

1. From the App Store, search for iView Remote (see icon below)



2. Download and Install to begin using an iPad as a remote control.

# VideoProbe\* 3D Measurement Handbook

A guide to advanced 3D measurement technologies, techniques and applications for video borescopes used in remote visual inspection applications.



# Get the most from your Mentor Visual iQ\*!

(Applies to Mentor Visual iQ software version 2.5 or later)

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## Introduction

Advances in image based 3D measurement are making the video borescope an increasingly powerful tool in the inspector's toolbox. While in the past, inspectors could identify indications and capture images; today's advanced video borescopes allow them to map, measure, and analyze indications in 3D and to share images and data wirelessly with remote experts. With enhanced precision and accuracy, this new functionality is allowing video inspection to complement, or in some cases, replace other NDT modalities.

This guide is designed to help inspectors and asset owners understand measurement technologies available on the Mentor Visual iQ and how they can be properly applied to improve decision making in remote visual inspection applications.

Many video borescope owners underutilize the advanced features of their inspection equipment due to a lack of training. Using this handbook as a guide, you can learn to apply new techniques, and make your expertise a competitive advantage for your organization.

## The Importance of Accurate Measurement

Remote visual inspection is frequently used to determine the serviceability of an asset. That determination is often based on the measurement of an indication or feature inside the asset. Inaccurate measurements can result in unnecessary downtime, scrap, and maintenance costs as well as safety or reliability risks. It is therefore critical that inspectors understand how to properly apply available measurement capabilities to maximize the quality of decision making.

With traditional measurement technologies, such as stereo, shadow, or comparison, the inspector has little ability to assess either the quality of the data used to compute the measurement result or the correctness of the cursor placement for the desired measurement. This can often lead to inaccurate measurements and potentially to costly incorrect decisions.

The latest 3D measurement technologies allow the real-time use of a 3D XYZ point cloud to check data quality and cursor placement accuracy from multiple angles and perspectives. This gives inspectors an unprecedented ability to check their work and avoid costly mistakes.

### Accurate VideoProbe measurement requires:

- A well-trained operator
- Properly calibrated and maintained equipment
- Choosing the correct measurement technology for the application
- Correct measurement tip positioning and measurement setup
- Analysis of data quality and cursor-placement accuracy

## Enabling Technology and Connectivity

When critical assets depend on accurate measurement, it may be time for a second opinion. For the first time, live video inspections can now be viewed in real time from a PC, tablet or smartphone across the room or around the world. The InspectionWorks Connect remote collaboration tool allows two-way collaboration and image annotation with field inspectors in real time using Wi-Fi or Ethernet connectivity.

By putting extra eyes on inspections, you'll benefit from greater expertise, improved probability of detection, better inspection productivity and reduced costs. InspectionWorks Connect is available as an option on all models of Mentor Visual iQ.



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# Measurement Technologies

(see Mentor Visual IQ Manual – Advantages of Measurement Types)

## 3D Phase Measurement

Using patented structured-light technology, 3D Phase Measurement enables inspectors to locate, measure and analyze an indication using the same tip optic. The wide field of view and large depth of field allow for measuring with the same tips used for inspecting, thus eliminating the extra steps required to back out, change the tip and then relocate the indication.

In effect, 3D Phase Measurement provides accurate measurement "on-demand" while saving time and increasing overall inspection productivity. 3D Phase Measurement employs structured light patterns projected from the tip to create a 3D surface scan of the viewing area and can measure all aspects of surface indications.

### Benefits:

- View and manipulate a 3D point cloud for detailed assessment of surface shape and measurement correctness
- Full-screen viewing of measurement image for greater resolution
- Navigate, inspect and measure without changing probes or tip optics
- Available on 6.1 mm diameter probes

## 3D Stereo Measurement

Introduced in 2015, 3D Stereo Measurement is GE's newest video borescope measurement technology. 3D Stereo Measurement utilizes the same optical tips as traditional Stereo Measurement but employs more advanced calibration and processing algorithms to generate a full 3D point cloud representation of the target surface that can be viewed, manipulated, and analyzed.

### Benefits:

- More accurate, repeatable measurement compared to traditional, outdated stereo or shadow measurement
- Provides better matching capabilities than Stereo Measurement on horizontal and repeating indications
- View the camera image and 3D point cloud side-by-side for highly efficient measurement analysis
- Measure effectively on shiny (or highly-reflective) surfaces which include detail
- Measure on surfaces with some minor movement present
- Available on 4.0, 6.1 and 8.4 mm probe diameters

## Stereo Measurement

Traditional stereo measurement, which, like 3D Stereo, utilizes a patented prism to obtain left and right stereo images from slightly different perspectives. The matching of surface points in the left and right images at the cursor locations allows 3D coordinates and measurement results to be computed. This technology, available for more than a decade, is useful on systems with limited computing power but does not provide a 3D point cloud and therefore limits the inspector's ability to assess measurement quality.

## Comparison Measurement

A more traditional 2D measurement technology that uses a physical reference target placed by the manufacturer or inspector at the same tip to target distance as the indication.

## PC Re-Measurement

Using software such as Inspection Manager to conduct post-inspection image measurement and analysis on a stored image. Today re-measurement capabilities are also available on-device using the Mentor Visual IQ system or on PC.

## 3D MEASUREMENT BEST PRACTICES: TECHNIQUES AND TIPS

These best practices apply to both 3D Phase Measurement and 3D Stereo Measurement. Use this best practice guide to provide the best results when setting up measurement with your VideoProbe. Additional guidelines for specific measurement types are listed on page 6.

### General Guidelines

- Ensure the inspector is trained and qualified to perform measurement.
- Use in-house procedures or the selector tool on this page to choose the appropriate measurement technology and type for your application.
- Ensure that your measurement tip and probe optics are clean and that the tip is securely attached. If using a stereo tip, be sure to correctly identify the tip serial number when first entering measurement. 3D Phase Measurement tips are automatically recognized by the system.
- Verify that the system measures accurately with the GE-supplied NIST traceable verification block before and after performing measurements.
- Position the tip as close as possible to the measurement area (low MTD value). Stereo and 3D Stereo require the image to be in focus, but with 3D Phase Measurement, small depth measurements (< 0.010") are generally most accurate when close enough for the image to be somewhat out of focus. Measuring from too far away is the most common cause of inaccurate measurements.
- Pay attention to warnings displayed by the system during measurement, which may signal improper setup or inappropriate MTD for the measurement performed.
- Check the measurement setup and cursor placement with 3D point cloud view. Many issues are difficult to recognize using the 2D image alone but are obvious in the 3D point cloud.
- When performing small depth or depth profile measurements, use the 3D point cloud view with depth map enabled to verify that the indication clearly stands out from the data noise. If not, capture another image from a closer distance or different orientation.
- When measuring the depth of a feature such as a pit or dent, use the point cloud view to verify that you are measuring at its deepest point and that the measurement reference plane is accurately aligned with the reference surface.
- With 3D Phase Measurement, reflections or shadowing can create regions of lower-quality data, which are highlighted in yellow. Avoid measuring in these areas whenever possible, especially for depth or depth profile measurements. Performing another capture from a different orientation may eliminate the yellow regions.
- Areas where the system was unable to determine 3D coordinates are highlighted in red. Measurements cannot be taken in these red areas.

### Choose the Right 3D Measurement Technology

Is a 4 mm or 8.4 mm probe required?

YES → 3D Stereo

NO

Are you measuring on highly-reflective, oily, or wet surfaces?

YES → 3D Stereo

NO

Is a side-view tip required?

NO → 3D Phase Measurement

YES

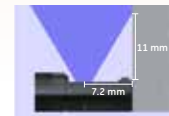
Do the viewing optics need to be very close to the end of the side-view tip to see into the inspection area due to mechanical obstructions?

NO → 3D Phase Measurement

YES → 3D Stereo



3D Stereo Side View



3D Phase Side View

- For best data quality, keep the probe as still as possible during image capture. This is particularly important with 3D Phase Measurement due to the large number of images captured.
- With 3D Stereo, adjust image brightness and viewing orientation to minimize glare in the area of interest prior to capturing a measurement image.
- Straight lines or edges on viewed objects often appear curved in the 2D image due to the viewing perspective and optical distortion. As all measurements are performed in 3D, the straight 3D measurement lines are drawn on the 2D image as they would be seen by the camera, which is often curved. This helps with alignment to straight edges and more accurately indicates measurement location.

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# Choose the Right Measurement Type For Your Application

While multiple measurement types may be used for certain applications, this chart is intended to show the expert recommendation.

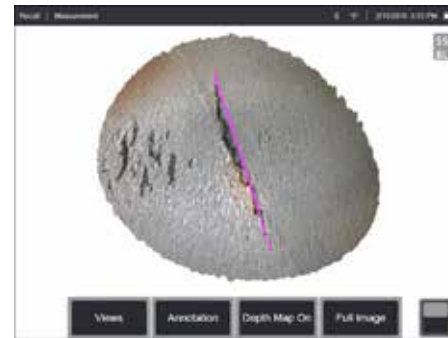


## MEASUREMENT TYPES



This section will detail each of the measurement types available on the Mentor Visual iQ videoprobe, suggest applications where each technique can be most effective, and provide tips and suggestions for accurate measurement setup.

### Length



Measures the straight-line distance between two selected cursor points.

#### Example Applications:

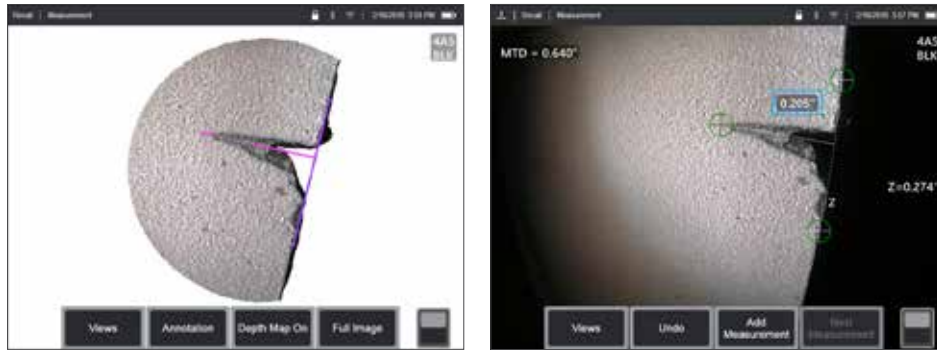
- Simple measurement of features or components
- Indication length measurement (i.e., cracks)
- Measurement of component size migration through expansion or erosion/corrosion/wear
- Determining the remaining size of wear indicators
- Measuring location/zone of indications on a part

#### Best Practices to Improve Measurement Accuracy:

- Length is a straight-line measurement. It is not suitable to measure the distance across a curved surface.
- Review the 3D point cloud to ensure your cursors are located correctly. Diagonal or off-angle measurements will induce error.
- Move the tip closer to make the target area as large on the screen as possible, while keeping the cursor point areas in focus.
- Watch for orange advisory indicators to ensure the measurement distance is within the confidence interval.
- In both 3D Phase and 3D Stereo measurement it is important to start with a crisp image so that the cursors can be placed accurately on the indication.
- Use a Measurement Plane when red areas prevent proper cursor placement or 3D noise may be affecting the result. See the Measurement Plane section for details.



## Point to Line



Measures the perpendicular distance between a line (defined by two points), and a selected point.

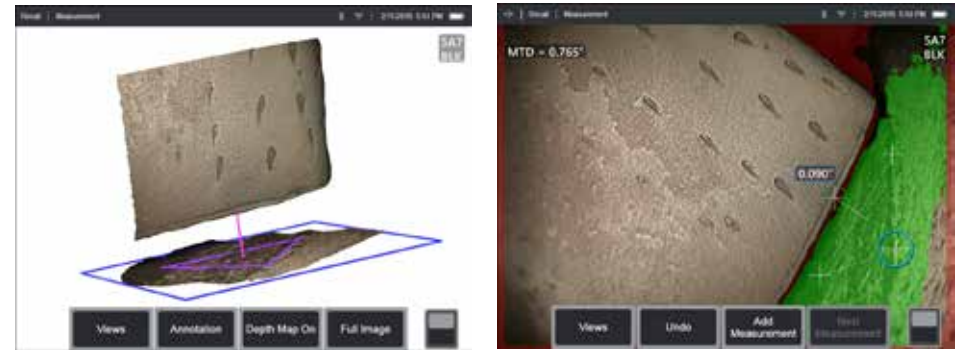
### Example Applications:

- Turbine blade edge damage
- Estimate missing corner area using multiple point-to-line measurements
- Gap or groove width
- Weld width

### Best Practices to Improve Measurement Accuracy:

- Review the 3D point cloud to ensure your cursors are located correctly.
- Check the point cloud to verify that the reference line is not tilted with respect to the reference edge on the part. This is especially important when both reference line cursors are on the same side of and away from the third cursor.
- Also check the point cloud to be sure the measured distance is not at a diagonal, which can give a higher-than-actual result.
- Use a Measurement Plane when red areas prevent proper cursor placement or 3D noise may be affecting the result. See the Measurement Plane section for details.

## Depth



Measures the distance from a reference plane (defined by three selected points) to a fourth selected point above or below the plane.

### Example Applications:

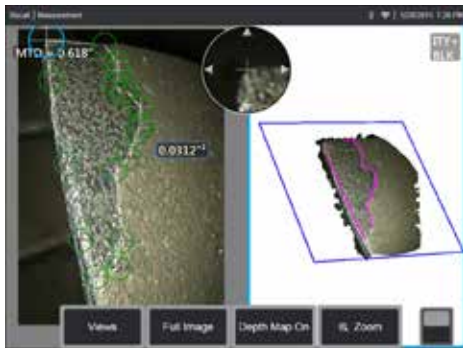
- Blade tip to shroud gaps
- Pits or dents from corrosion, erosion, or FOD impact
- Pipe inside diameter
- Weld height
- Stator vane rock
- Gap width



### Best Practices to Improve Measurement Accuracy:

- The measurement tip should be as close as possible to the indication to increase the accuracy of measurement.
- When using 3D Phase Measurement, off-perpendicular views yield the best results for depth measurements, especially when measuring objects with shiny surfaces.
- The green Surface Mask visible when a reference plane cursor is active indicates points very close to the reference plane. Adjust the cursor positions to maximize the amount of green on the reference surface. The 3D point cloud view can also be used to verify that the reference plane, indicated by a blue square, is accurately aligned with the reference surface.
- After the third cursor is placed, the Depth Assist feature will often automatically place the fourth cursor at the deepest point, highest point, or on a blade edge nearby. Check the position of the auto-placed cursor and adjust if necessary.
- Enable depth map mode in the point cloud view to better see surface contours and ensure that you are measuring the desired point—often the highest or lowest on an indication—and that the indication clearly stands out from the 3D data noise.
- The line projected from the depth measurement point should end near or within the triangle formed by the reference-plane cursors to minimize inaccuracy due to plane tilt.
- If you must measure at a point far outside the reference triangle, increase the size of your reference triangle to compensate (this only applies to flat surfaces, not curved surfaces).
- Use a Measurement Plane when measuring blade tip to shroud clearance and red areas along the blade edge prevent proper fourth cursor placement or 3D noise may be affecting the result. See the Measurement Plane section for details.

## Area



Measures a planar area on a surface by outlining an indication with multiple cursor points.

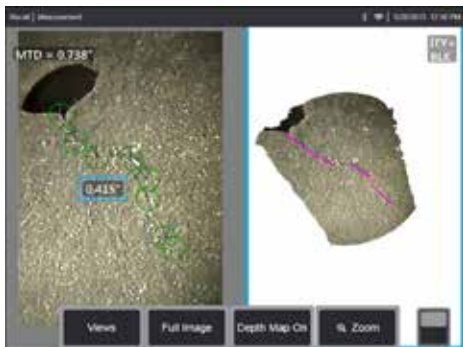
### Example Applications:

- Missing blade corners using a Measurement Plane
- Coating loss
- Surface area of pitting or corrosion
- FOD impact damage

### Best Practices to Improve Measurement Accuracy:

- Check the point cloud to ensure accurate cursor placement.
- When measuring a curved surface, reduce error by measuring multiple smaller areas and combining the results.
- Use with a Measurement Plane to measure area and lengths of blade missing corners. See Measurement Plane section for details.

## Multi-segment



Measures the total length along a curved or jagged path using multiple cursors placed along the path of the indication. When three cursors are used, it also provides the 3D angle between the line segments.

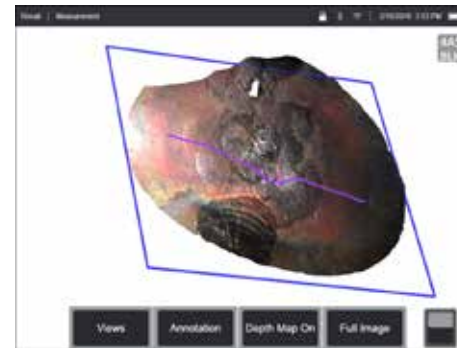
### Example Applications:

- Total travel path of a complex crack
- Total length along a curved surface
- Use three cursors to measure the angle between a turbine blade edge and an indication or blended area

### Best Practices to Improve Measurement Accuracy:

- Check the point cloud to ensure accurate cursor placement.
- Space your cursors as far apart as possible while following the path of the indication to minimize the effect of 3D data noise on the result.
- If measuring an angle (only provided with three cursor Multi-segment) along an edge, accuracy may be improved by using a Measurement Plane.

## Depth Profile



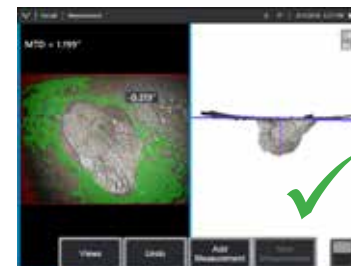
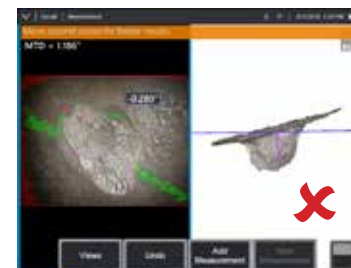
From any viewing angle, maps the perpendicular distance from a reference plane along a line between two selected points and automatically identifies the deepest or highest point.

### Example Applications:

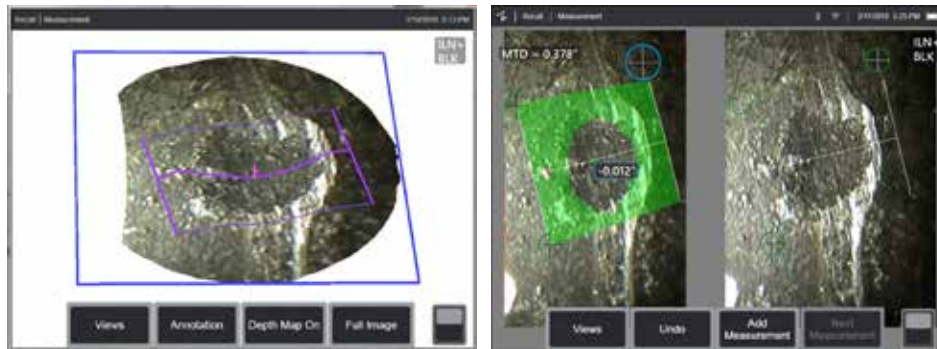
- Depth of isolated corrosion or erosion pits
- Depth of FOD impact damage
- Weld height or wear groove depth
- Quick assessment of surface contours

### Best Practices to Improve Measurement Accuracy:

- Position the measurement tip as close as possible to the indication to increase measurement accuracy.
- Enable depth map mode in the point cloud view to better see surface contours and ensure that you are measuring the desired point—often the highest or lowest on an indication—and that the indication clearly stands out from the 3D data noise.
- The green Surface Mask visible when a cursor is moved indicates points very close to the reference plane. Adjust the cursor positions to maximize the amount of green on the reference surface. The 3D point cloud view can also be used to verify that the reference plane, indicated by a blue square, is accurately aligned with the reference surface.
- If the cursor turns red, this indicates improper placement.
- As the reference plane is determined by fitting to all the surface data within both cursor perimeters, ensure that the two cursors are fully positioned on the same plane of interest—not overlapping an edge, or on offset or curved surfaces that could cause measurement error.
- If measuring on a curved surface, such as inside a small pipe, space the cursors apart in a direction parallel to the curvature to keep them on the same plane. In the point cloud view, the blue reference-plane square should appear tangent to the reference surface.
- In applications seeking the deepest or highest point, Area Depth Profile or Depth may be preferred over Depth Profile as they automatically identify the deepest or highest point in an area.



## Area Depth Profile



Sweeps a series of depth profile slices over an area defined by three cursors and identifies the profile slice having the highest or lowest point.

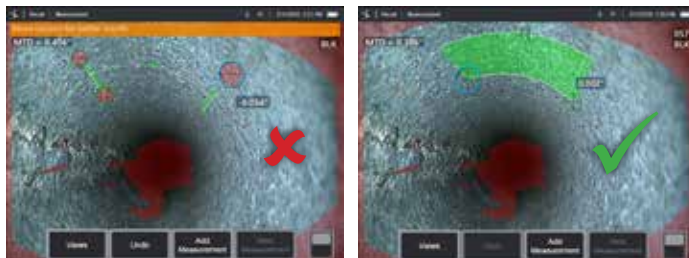
### Example Applications:

- Corrosion, erosion and pitting
- FOD impact damage
- Maximum weld height including orbital welds
- Maximum wear groove depth

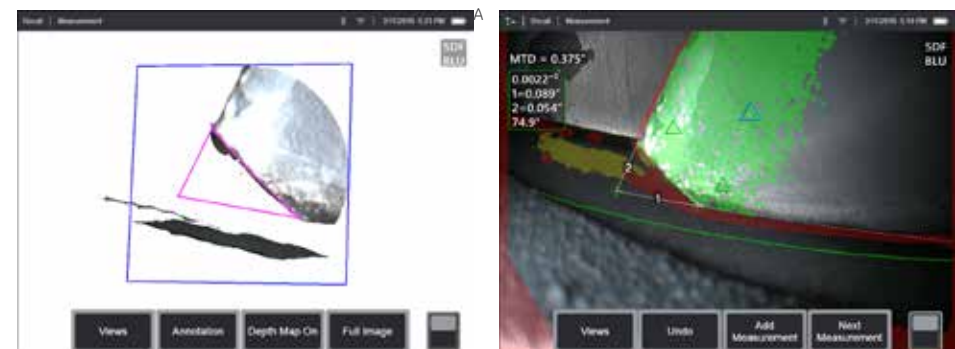
### Best Practices to Improve Measurement Accuracy:

- Position the measurement tip as close as possible to the indication.
- Use with reference surfaces that are flat or have curvature in only one direction, such as a straight section of a pipe. Do not use on surfaces with complex curvatures such as a pipe elbow or turbine blade root at the leading or trailing edge.
- When measuring on a curved surface, position the cursors such that the reference profile lines are curved. If unsure of proper orientation, practice on a test piece of the same shape. When cursors are properly placed, you should get a result close to zero, and most of the area should be shown in green. See images below.

- The green Surface Mask visible when moving the cursors indicates points very close to the reference planes of the depth profile slices. If you only have a small line of green near the two reference profile lines, you are likely positioning the lines incorrectly on a curved surface. See images below.
- The reference profile lines follow the surface curvature and are used to determine the reference planes for the profile slices. Position the cursors such that the reference profile lines are fully on the reference surface.
- Use the 3D point cloud to verify that the reference plane for the result slice, indicated by a blue square, is accurately aligned with the reference surface at the location of the result slice.
- The first two cursors define the first reference profile line. The third cursor sets the distance between the second reference profile line and the first. The system determines the endpoints of the second reference profile line to match the curvature of the surface along the first. If you have difficulty getting the second reference profile line where you want it, you are likely not setting up the measurement correctly with respect to surface curvature.



## Measurement Plane



Measurement aid used in conjunction with other measurement types to allow the placement of cursors in red areas where no 3D data is present or where noise in the 3D data may be reducing measurement accuracy.

### Example Applications:

- With Area to measure missing corners
- With Point to Line for blade edge damage
- With Depth for blade tip to shroud gaps
- With Length or Point to Line for small features when unable to get closer
- With Area Depth Profile when measuring a field of pits on a flat surface
- With Depth Profile when you cannot fit the cursors fully on a flat reference surface

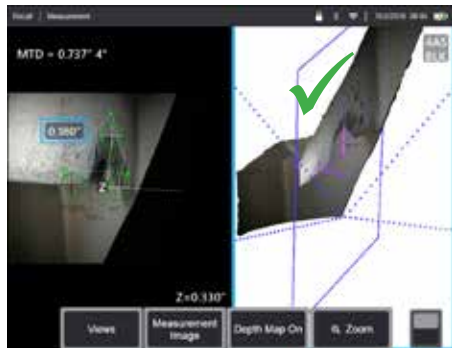
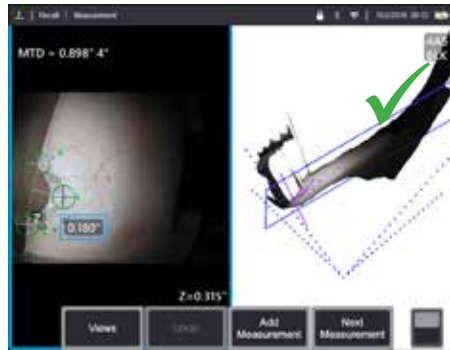
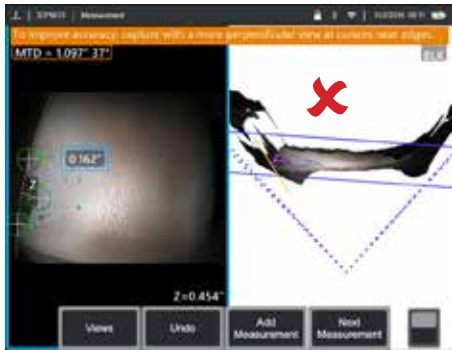
### Effect of a Measurement Plane on other measurement types:

- **Length, Point to Line, Multi-Segment, and Area:** All cursors are projected onto the Measurement Plane, and the result is computed using the projected positions on the plane.

- **Depth:** The first three cursors select individual surface points as with a normal Depth measurement. Only the fourth is projected onto the Measurement Plane.
- **Depth Profile:** The Measurement Plane is used as the reference plane, so the Depth Profile cursors may overlap edges or be in red areas. The result is the height or depth from the Measurement Plane. Use only with flat reference surfaces.
- **Area Depth Profile:** Both reference lines are positioned on the Measurement Plane allowing them to pass through red areas or surface pits without affecting the profiles taken between the reference lines. The result is the height or depth from the Measurement Plane. Use only with flat reference surfaces.
- Only one Measurement Plane can be used on an image.
- If a Measurement Plane is present, all other measurements use it regardless of the order in which they were placed.



## Measurement Plane EVA Warnings

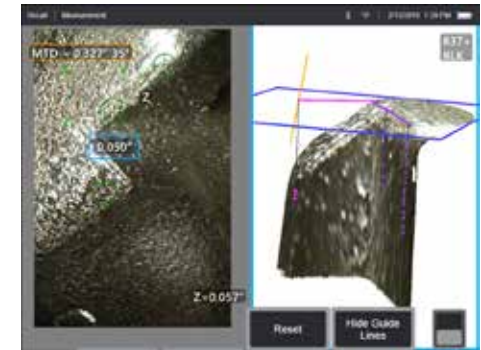
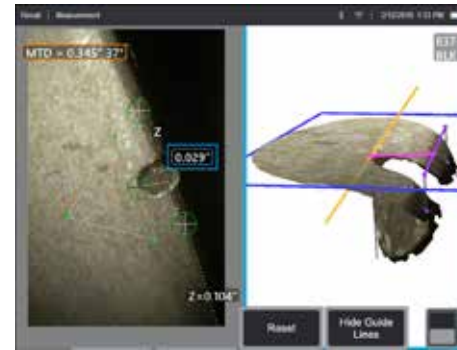


When using a Measurement Plane with Point to Line, Area, or Depth to measure near an edge, the viewing perspective can affect accuracy, especially if the edge has a significant radius. To help the user maximize accuracy, the system displays an Edge View Angle (EVA) value next to the MTD and an Edge View Angle Line (EVA Line) in the point cloud views. The ideal EVA of 0° occurs when the EVA Line is perpendicular to the Measurement Plane. Measurement error generally increases as the EVA increases when measuring near a rounded edge. If the EVA exceeds an upper limit (25° for Point to Line, 35° for Area and Depth) with cursors placed near an edge, the system displays a warning message, flashes an orange outline around the MTD and EVA, and shows the EVA Line in orange. To reduce the EVA, inspect the Full Image point cloud, in which the four dotted 3D Perspective Lines show the corners of the field of view, and visualize how the relative positions of the tip and the object must be adjusted to make the EVA Line more perpendicular to the Measurement Plane, shown as a solid blue rectangle. Capture a new image with the adjusted positions, and repeat the measurement.

### Some points regarding the Edge View Angle (EVA):

- It is the angle between the Measurement Plane and an Edge View Plane determined using two 3D coordinates on the edge and the origin of the field of view where the four dotted 3D Perspective lines in the Full Image point cloud converge. To help visualize this concept, open the front cover of a hardcover book and hold the edge of the cover up close to your eye. The cover represents the Edge View Plane, the first page represents the Measurement Plane, the joint between them represents the edge of the surface, and the angle between them represents the EVA.
- Moving cursors along a straight edge has little impact on the EVA because the Edge View Plane does not change.
- The EVA depends on the position of the edge in the image. The top left image shows a poor EVA when measuring near the left side of the image with a perpendicular view at the center. The right image shows a much better perspective at the part edge, which is reflected in the low EVA.
- Rotating a side-view tip in a fixed position (e.g., borescope port) has little impact on the EVA. Movement of the viewed object or translation of the tip is generally needed.
- As shown in the lower left image, achieving a low EVA does not require a perpendicular view of the part. In the book analogy, you can tilt and move the book while maintaining a 90° angle between the cover and the first page.
- If the edge along which the measurement is performed has a small edge radius relative to the measured dimension, accurate results can be achieved even with an EVA warning present when the edge is coming toward the probe tip. Avoid measuring with high EVA values on edges going away from the tip.
- See the "Measurement Plane Guide Lines" section for measuring on rounded edges with high EVA values.

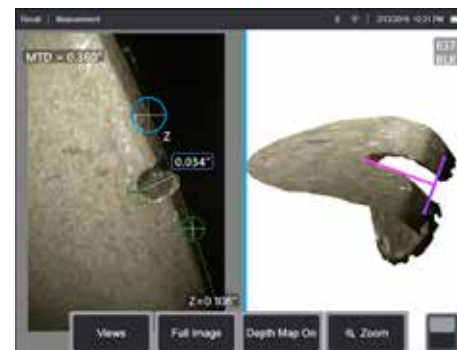
## Measurement Plane Guide Lines



Guide Lines are shown in the point cloud views when using a Measurement Plane with Length, Point to Line, Multi Segment, or Area. They are shown as black lines that are perpendicular to the Measurement Plane and extend from the cursor locations on the Measurement Plane to surface points straight above or below the cursor locations. Spheres are shown where Guide Lines intersect the surface.

### Example Applications:

- Edge damage on rounded turbine blade or vane edges
- Turbine vane platform to shroud gaps
- Edge radius estimates
- Gap width
- Any in-plane dimensions between points not on the same plane



Conventional Measurement on a Diagonal

### Best Practices to Improve Measurement Accuracy:

- Adjust the cursor positions in the 2D image until the Guide Lines and surface spheres appear on the surface in the desired locations.
- Use when measuring on rounded edges and an in-plane measurement like that obtained using an optical comparator is desired. The conventional Point to Line measurement of a rounded leading edge indication in the lower left image is on a diagonal and therefore gives a larger result than would be obtained using an optical comparator. The same indication is measured in the top left image using a Measurement Plane with Guide Lines to remove the angle.
- Cannot be reliably used if the EVA is more than about 10° and the rounded edge is away from the probe tip.
- Cannot be used when the 3D data does not extend all the way to the edge of the surface.
- Should be used to guide cursor positioning on rounded edges oriented toward the probe tip, especially when the EVA exceeds about 15°. The rounded edge is off the measurement plane, so unless the EVA is low, the cursors cannot be placed properly using only the 2D image. This is especially true with higher EVA values that generate warnings as shown in the above two images.

## Measurement Plane Examples

### Turbine blade missing corner dimensions:

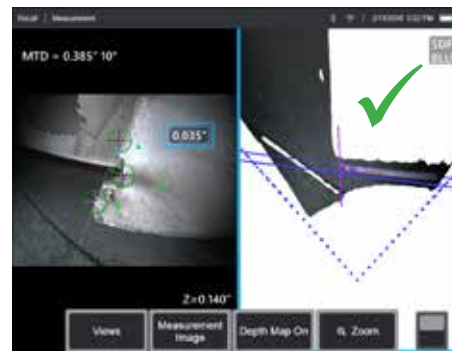
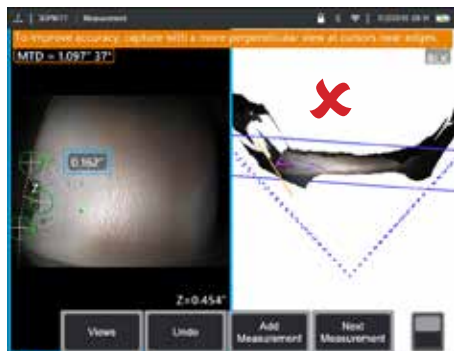
- Use a Measurement Plane with Area.
- Position the probe tip according to recommendations in the Measurement Plane EVA Warnings section.
- Place the Measurement Plane on the face of the blade near the missing corner.
- Place an Area measurement with one cursor on each remaining corner, one cursor out in space where the corner used to be, and as many as are needed to follow the broken edge.
- After pressing "Done", adjust the cursors so that the extended lines line up with the blade edges near the missing corner region.
- The missing area, missing edge dimensions, and the corner angle are all provided eliminating the need for additional measurements.



### Turbine blade edge indication:

- Use a Measurement Plane with Point to Line when 3D data along the blade edge is missing or noisy.
- Position the probe tip according to the recommendations in the Measurement Plane EVA Warnings section.
- Place the Measurement Plane on the face of the blade near the indication.

- Add a Point to Line measurement with the first two cursors placed on the edge of the blade and the third at the inner edge of the indication.
- The Edge View Angle (EVA) is displayed next to the MTD. The lower the EVA, the better the accuracy, especially when measuring on a rounded leading edge. When making a critical call, try to achieve an EVA of less than 15°.



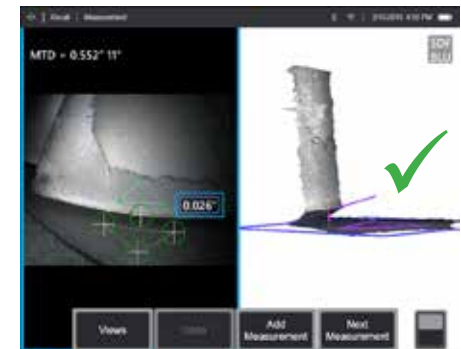
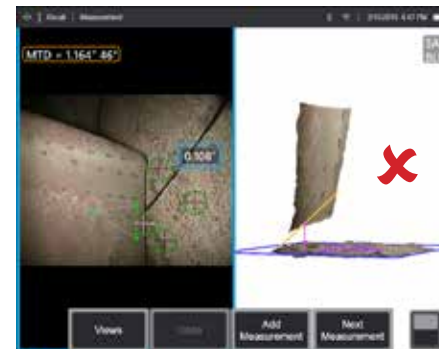
## Measurement Plane Examples

### Turbine blade tip to shroud clearance:

- Use a Measurement Plane with Depth when 3D data at the edge of the blade is missing, noisy, or drawn down and back toward the shroud as shown in the lower right image.
- Position the probe tip low to the shroud so that you can see back under the blade. The left image below is captured from too far above the shroud as indicated by the 46° EVA.
- Place the Measurement Plane on the face of the blade near the desired measurement point. Too much spacing between

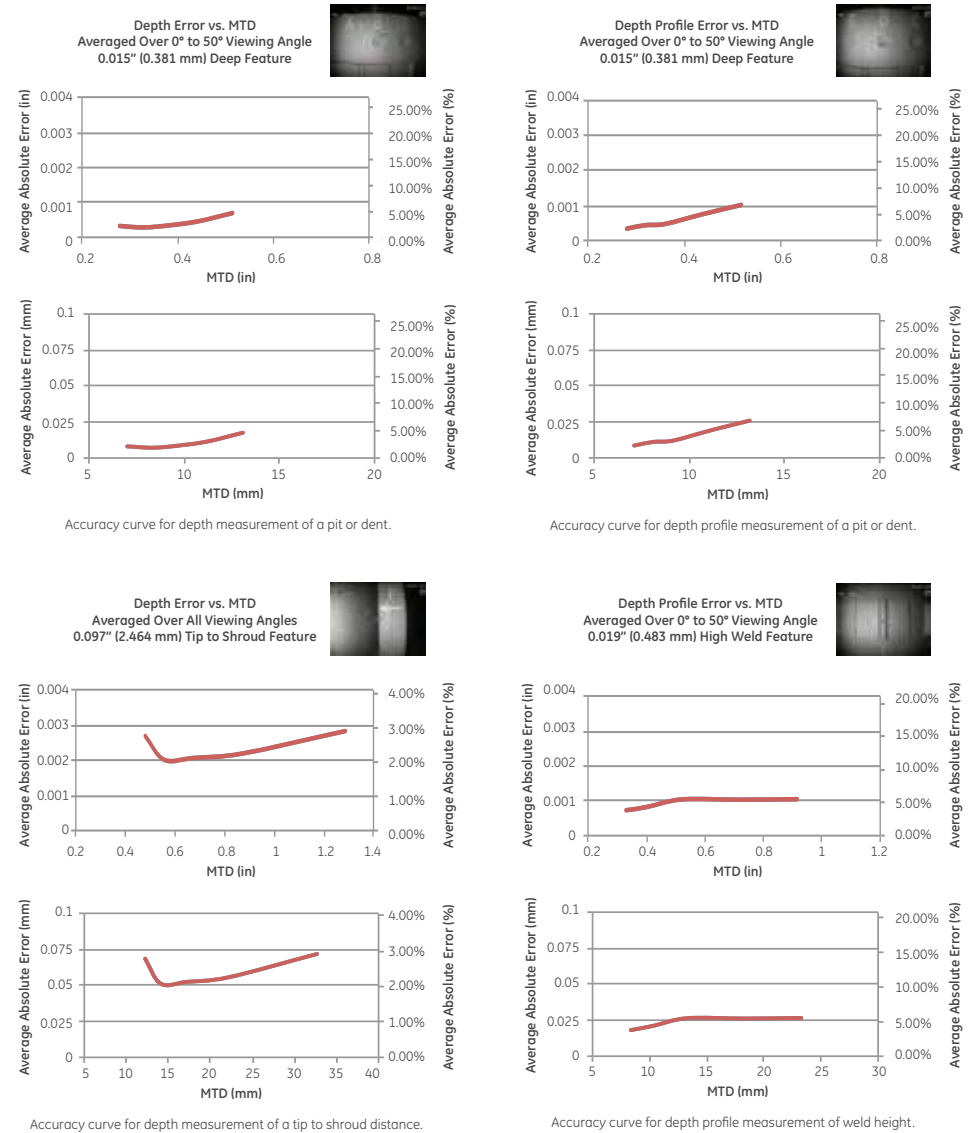
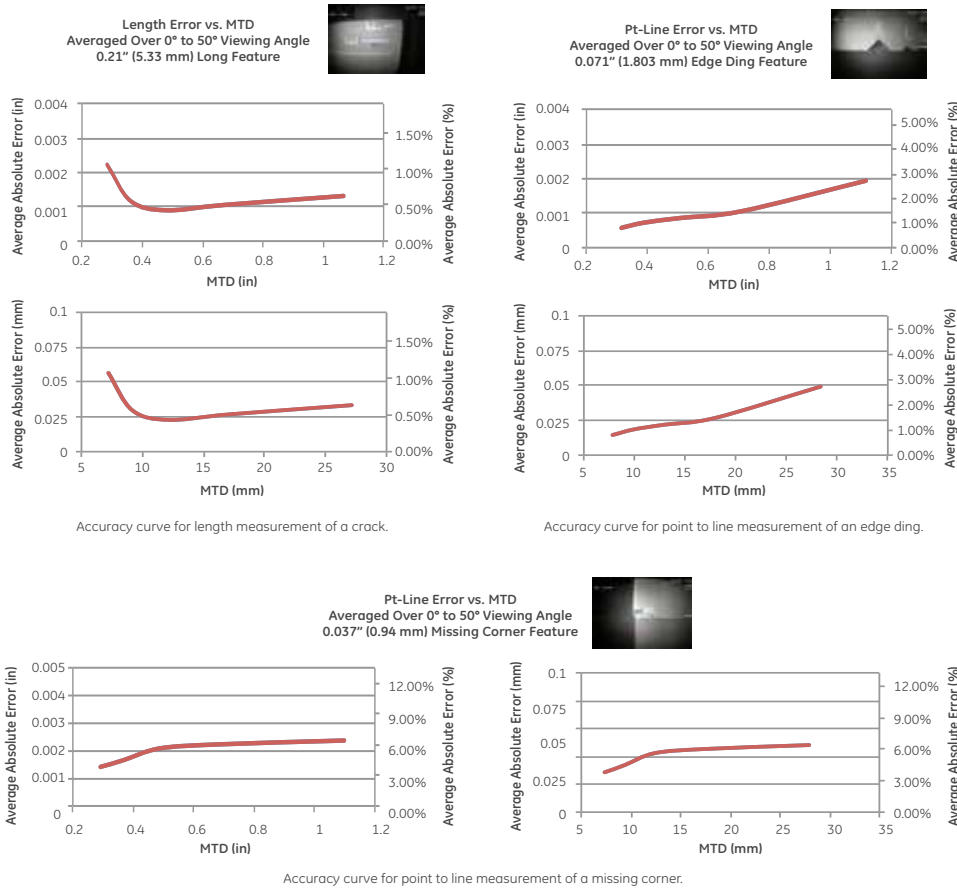
the cursors near the blade edge can increase error due to blade curvature.

- Place the first three Depth cursors on the shroud.
- Position the fourth Depth cursor at the edge of the blade in the 2D image. This cursor is projected onto the Measurement Plane, so it may appear slightly off the edge in the point cloud due to missing or noisy 3D data at the edge.



## MEASUREMENT ACCURACY DATA

The measurement accuracy curves on pages 18-19 were created from trained third party test results using 3DPM on a Mentor Visual iQ under controlled conditions with a matte finish test block. They should be interpreted as system capability under ideal conditions. Actual results vary with application, surface conditions, equipment condition, and user expertise.



Note: Measurement Planes were not used in this testing but would likely improve the results on some features.



# SPECIFICATIONS

## Measurement Tip Optic Specs and Part Numbers for Mentor Visual iQ

### Mentor Visual iQ 4.0 mm Tips

#### 3D Stereo Measurement and Stereo Measurement Tips

Part No.	Color	FOV (deg)	DOF mm	(in)
TM405555FG	Black	55/55-FWD	5-inf	(.20-inf)
TM405555SG	Blue	55/55-SIDE	4-inf	(.16-inf)

### Mentor Visual iQ 6.1mm Tips

#### 3D Phase Measurement Tips

XL4TM61105FG (forward version)	Black	105	8-250	(.31-9.84)
XL4TM61105SG (side version)	Blue	105	7-250	(.27-9.84)
XL4TM61105FN-8651	Orange	105	3-120	(.12-4.72)

#### 3D Stereo Measurement and Stereo Measurement Tips

XLG3TM616060FG	Black	60/60-FWD	4-80	(.16-3.15)
XLG3TM615050SG	Blue	50/50-SIDE	2-50	(0.8-1.97)

### Mentor Visual iQ 8.4mm tips

#### 3D Stereo Measurement and Stereo Measurement Tips

XLG3TM846060FG	Black	60/60-FWD	4-50	(.16-1.97)
XLG3TM846060SG	Blue	60/60-SIDE	4-50	(.16-1.97)

## Measurement Software Part Numbers

3D Stereo Measurement	MVIQ-3DPM
3D Phase Measurement	MVIQ-3DST
Stereo Measurement	MVIQ-ST
Projected Plane Measurement	MVIQ-PPM
Area Depth Profile	MVIQ-ADP

# Glossary

**3D Perspective Lines** – Dotted blue lines showing the four corners of the tip field of view in the full image point cloud to help the user understand and improve tip orientation relative to a surface. May be shown or hidden via the settings menu.

**3D Phase Measurement** – A measurement technology that projects line patterns on an object via a series of LEDs. Measurements are calculated using the concept of phase shift analysis combined with proprietary processing technology.

**3D Point Cloud** – A 3D graphical representation of the surface being inspected with lines and spheres added to show measurements made on that surface. The 3D point cloud can be rotated and viewed from multiple angles and perspectives. It allows an inspector to check the setup of their measurement and cursor placement points.

**3DPM Range Guide** – Visual aid displayed when viewing live video with a 3DPM tip attached to indicate the system's ability to achieve sufficient brightness with the tip LEDs for a high-quality scan. Increasing the number of bars by moving closer to the target will increase 3D data quality and measurement accuracy.

**3D Stereo Measurement** – Uses the same optical principles as Stereo Measurement and combines these with the ability to create, manipulate and analyze a 3D Point Cloud representation of measurement data.

**Active Cursor** – The cursor currently being manipulated, indicated by a blue circle.

**Advisory Message** – “For best results the reference cursors should be on the same plane” – In depth profile measurement, indicates the reference cursors are not on the same plane.

**Advisory Message** – “Move closer to target or move cursors for better results” – Indicates that the measurement is too small to be reliable at the current tip to target distance. Can be remedied by moving tip closer to the indication or selecting larger measurement area.

**CSV** – Comma separated value, used for point cloud file data export. Can be opened in a CAD package.

**Depth Assist** – Feature wherein the the system searches the surface data in the vicinity of the first three cursors of a Depth measurement and automatically places the fourth cursor at the deepest point, highest point, or a point on a blade tip saving the user the time of locating those points manually.

**Depth Map** – 3D point cloud viewing mode in which either the tip to target distance (full image) or the perpendicular distance from the measurement reference plane (measurement image) is color coded to provide better understanding of 3D data noise levels and surface contours.

**Depth Profile View** – Alternative 2D view of depth profile along a selected depth profile line.

**Edge View Angle (EVA)** – Displayed next to the MTD to help the user gauge the suitability of the viewing perspective when making a Point to Line, Depth, or Area measurement near the edge of a surface using a Measurement Plane.

**Edge View Angle Line (EVA Line)** – Line shown in the point cloud indicating where the EVA is determined. The EVA is 0° when the EVA Line is perpendicular to the measurement plane.

**FOD** – Foreign Object Damage.

**Full Image Point Cloud** – Shows all measurements and surface data. The depth map indicates the distance from the measurement tip to the surface.

**Guide Lines** – Lines shown in the point cloud views when using a Measurement Plane with Length, Point to Line, Multi Segment, or Area to help the user position cursors to align with out-of-plane surface points.

**InspectionWorks Connect** – Remote collaboration tool allowing live remote viewing of inspection video, two-way chat and annotation. Can be activated directly on the Mentor iQ handset.

**Inactive Cursor** – Cursors not currently selected, indicated by a green circle.

**Inspection Manager** – PC-based re-measurement tool for visual inspection images.

**Measurement Image Point Cloud** – Shows only the active measurement and surface data in its vicinity. The depth map indicates the perpendicular distance of the surface points from the measurement's reference plane.

**Missing Corner** – The corner of a turbine blade that has been broken off usually by a foreign object passing through the turbine.

**MTD** – Maximum target distance. Identifies the distance of the furthest cursor point in a given measurement from the tip of the probe.

**Noise in the Point Cloud** – Artifacts in the 3D data not representative of true surface geometry. Noise is generally reduced by moving the tip closer to the target surface or changing angle of approach to reduce reflections.

**Orange Outline Around Measurement Results and MTD Value** – Indicates that the measurement is too small to be reliable for the current tip to target distance. Can be remedied by moving tip closer to measurement or selecting larger measurement area.

**Profile Slices** – Paths along the surface between the reference profile lines in an Area Depth Profile Measurement that map the perpendicular distance between the surface points and the reference surface.

**Projected Plane Measurement** – The use of a Measurement Plane in combination with another measurement type to mathematically project the plane of a surface over the entire image and measure on that plane.

**Red Filled Cursors on Depth Profile** – Indicates cursor is not on a flat surface or not on the same plane. Cursor must be repositioned for accurate measurement.

**Red Mask on Image** – Indicates surface data in this area is not available for measurement. Moving closer or adjusting viewing orientation may reduce red mask area.

**Reference Line** – In a point to line measurement, the first two cursors, placed on unaltered surface points, define a straight reference line in 3D space from which the distance to the third cursor point is measured.

---

**Reference Plane** – The plane, defined by three or more points on a reference surface, from which the perpendicular distance to other surface points is computed. A blue square indicates the reference plane position in the measurement image 3D point cloud view.

**Note:** A reference plane is calculated as flat, even if the surface the plane rests on is not flat. This is a potential source of error.

**Reference Profile Line** – Area Depth Profile lines set by the measurement cursors that follow the surface contours and are used to determine the area and reference planes for the profile slices.

**Reference Surface** – Unaltered part surface to be used as a reference for various measurements.

**Result Slice** – The Area Depth Profile profile slice that includes the highest or lowest point and is shown on the image and in the point cloud.

**Surface Mask** – Shows surface points very close to the measurement reference plane in green to help the user establish accurate reference planes with Measurement Plane and Depth, Depth Profile, and Area Depth Profile measurements.

**Yellow Mask on Image** – With 3D Phase Measurement, indicates surface data may be of low quality for measurement. The potential for reduced accuracy may exist, especially for depth or small measurements. Yellow mask areas are often caused by surface to surface reflections. Changing the probe orientation to make such reflections bounce away from the probe tip may improve data quality and reduce or eliminate yellow mask areas.

## Appendix Q - MViQ EIRP Values

<b>802.11b</b>				
	Measured Power (dBm)	Output Power (dBm)	EIRP (dBm)	Limit (dBm)
<b>2412 MHz</b>				
Normal	14.77	15.57	18.07	20.00
<b>2442 MHz</b>				
Normal	14.18	14.98	14.98	20.00
<b>2437 MHz</b>				
Normal	14.37	15.17	15.17	20.00
<b>802.11g</b>				
	Measured Power (dBm)	Output Power (dBm)	EIRP (dBm)	Limit (dBm)
<b>2412 MHz</b>				
Normal	12.62	13.40	15.90	20.00
<b>2442 MHz</b>				
Normal	14.94	15.72	15.72	20.00
<b>2437 MHz</b>				
Normal	15.42	16.20	16.20	20.00
<b>802.11n HT20</b>				
	Measured Power (dBm)	Output Power (dBm)	EIRP (dBm)	Limit (dBm)
<b>2412 MHz</b>				
Normal	12.15	13.27	15.77	20.00
<b>2442 MHz</b>				
Normal	15.24	16.36	16.36	20.00
<b>2472 MHz</b>				
Normal	15.20	16.32	16.32	20.00
<b>802.11n HT20 MIMO</b>				
	Measured Power Chain 0 (dBm)	Measured Power Chain 1 (dBm)	Output Power (dBm)	EIRP (dBm)
<b>2412 MHz</b>				
Normal	9.24	9.23	13.37	15.87

2442 MHz				
Normal	11.08	11.27	15.31	17.81
2472 MHz				
Normal	10.54	10.76	14.78	17.28
802.11n HT40				
	Measured Power Chain 0 (dBm)	Measured Power Chain 1 (dBm)	Output Power (dBm)	EIRP (dBm)
2422 MHz				
Normal	5.20	6.57	11.67	14.17
2442 MHz				
Normal	10.72	11.42	16.81	19.31
2462 MHz				
Normal	11.05	10.48	16.50	19.00
5150 MHz to 5350 MHz				
			Transmitter power (dBm EIRP)	
Antenna	Duty cycle	Modulation	Lowest channel	Middle channel
1	0.99	6 Mb OFDM	20.8	20.8
1	0.92	54 Mb OFDM	21.0	20.6
1	0.99	HT0 - 20 MHz	20.9	20.3
2	0.99	HT0 - 20 MHz	21.1	20.9
1+2	0.98	HT8 - 20 MHz	21.9	21.8
1	0.85	HT7 - 40 MHz wide	18.9	20.5
2	0.85	HT7 - 40 MHz wide	19.4	20.8
1+2	0.79	HT15 - 40 MHz wide	19.5	21.4
1	0.95	VHT0 - 80 MHz wide	17.2	-
2	0.95	VHT0 - 80 MHz wide	17.8	-
1+2	0.72	VHT9 - 80 MHz wide	19.5	-
5470 MHz to 5725 MHz				
			Transmitter power (dBm EIRP)	
Antenna	Duty cycle	Modulation	Lowest channel	Middle channel

---

1	0.99	6 Mb OFDM	20.0	20.6
1	0.92	54 Mb OFDM	19.8	20.6
1	0.99	HT0 - 20 MHz	19.8	20.5
2	0.99	HT0 - 20 MHz	20.6	20.5
1+2	0.98	HT8 - 20 MHz	21.4	21.8
1	0.85	HT7 - 40 MHz wide	19.4	20.2
2	0.85	HT7 - 40 MHz wide	19.4	20.5
1+2	0.79	HT15 - 40 MHz wide	20.7	21.6
1	0.95	VHT0 - 80 MHz wide	17.8	-
2	0.95	VHT0 - 80 MHz wide	18.7	-
1+2	0.72	VHT9 - 80 MHz wide	19.5	-

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